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With METALLURGICAL SUPPLEMENT.

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VOL. CLIV.—No. 4007] LONDON: FRIDAY EVENING, OCTOBER 28, 1932 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

LIFTS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS, before 11 a.m. on Monday, 14th November, 1932, for the SUPPLY and ERECTION of TWO DIRECT-ACTING HYDRAULIC LIFTS at the Letter Office, Mount Pleasant, E.C.

Drawings, specification, a copy of the conditions and form of contract and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W.1, on payment of One Pound. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 9092

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 16th November, 1932, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at the Telephone Exchange, Euston, N.W.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W.1, on payment of One Pound. The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 9091

Fulham Borough Council.

GENERATING STATION EXTENSIONS.

The Fulham Borough Council is prepared to receive TENDERS for the following ENGINEERING WORKS in connection with the Extension of the Council's Generating Station in Townmead-road, Fulham, viz.:—

SECTION "F."—OVERHEAD ELECTRIC TRAVELLING CRANES.—The Manufacture, Delivery, Erection, and Maintenance of :—

(A) One 120-Ton Overhead Electric Travelling Crane for the Turbine Room.

(B) One 15-Ton Overhead Electric Travelling Crane for the Circulating Water Pump Bay.

The specification may be inspected at the office of Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W.1, to whom all technical inquiries should be addressed.

Copies of the specification (in duplicate), together with the general conditions and form of Tender, may be obtained on written application to the Borough Treasurer at the Town Hall, Fulham, S.W.6, accompanied by a deposit of £5. This deposit will be returnable only if the tenderer shall have sent in a bona fide Tender within the prescribed time and shall not have withdrawn the same. Additional copies of the specification may also be obtained upon payment to the Borough Treasurer of £1 for each copy, which will not be returnable.

Tenders must be submitted in the printed envelopes provided, and all Tenders must be sealed and appropriately endorsed, and delivered to the undersigned not later than 10 a.m. on Friday, 18th November, 1932.

The Council will not consider any Tender which does not cover the whole of the works specified. The Council will also not necessarily accept the lowest or any Tender, or compensate for the preparation of unsuccessful Tenders.

WILFRED TOWNEND,
Town Clerk.

Town Hall, Fulham, S.W.6,
19th October, 1932. 9088

The Rural District Council of Wallingford.

CHOLSEY WATER SUPPLY.

The Council invite TENDERS for the SUPPLY, ERECTION, FIXING, and RUNNING for a period of a TEMPORARY PUMPING PLANT required for the purpose of testing the yield of an existing bore-hole in Honey-lane, Cholsey, Berks.

Copy of particulars of the work may be obtained from the Engineers, Messrs. Fiddian and Deeley, 13, Church-street, Stourbridge, on and after the 4th November next, upon payment of One Guinea deposit, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Test Pumping," to be delivered at my offices not later than Noon on Friday, the 18th November, 1932.

The Council does not bind itself to accept the lowest or any Tender.

By Order,
P. C. A. SLADE,
Clerk to the Council.

7, St. Martin's-street,
Wallingford, Berks.,
October 26th, 1932. 9101

County Borough of Southampton.

APPOINTMENT OF A SUPERINTENDENT IN THE WATERWORKS DEPARTMENT.

The Corporation invite APPLICATIONS for the POSITION of SUPERINTENDENT in their Waterworks Department.

Applicants should have a thorough knowledge of water fittings, water meters, plumbing, the laying and repairing of water mains and the maintenance of motor vehicles, and should not be more than 40 years of age. Experience in the duties of Superintendent in other waterworks undertakings will be advantageous.

The person appointed will be required to organise the labour and transport of the Department, other than that employed at the Pumping Stations, to supervise the system of inspection and waste detection within the whole of the Corporation's area of supply, and to carry out such other duties as may from time to time be allotted to him. He will hold office during the pleasure of the Council. His salary will be £350 per annum, subject to a temporary abatement (at present £5 per annum). A motor car allowance of £125 per annum will also be paid. He will be required to live within two minutes' walk of the Waterworks Depot, in Shirley-road, where accommodation for a motor car will be provided.

The Local Government and Other Officers' Superannuation Act, 1922, will be applicable to the appointment and contributions to the Superannuation Fund will be deducted from the salary. The selected candidate will be required to pass a satisfactory medical examination.

Applications, stating previous and present appointments, experience, date on which appointment could be taken up, and any other relevant particulars, and accompanied by copies of not more than three recent testimonials, must be enclosed in sealed envelopes and endorsed "Appointment of Superintendent," and addressed to the Town Clerk, Municipal Offices, Southampton, and delivered there on or before 19th November, 1932.

Canvassing is prohibited and will disqualify.

E. RONALD H. MEGGESON,
Town Clerk.

22nd October, 1932. 9089

The Engineer

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Mersey Tunnel Joint Committee.

MECHANICALLY PROPELLED CLEANING APPARATUS.

The Mersey Tunnel Joint Committee are prepared to receive ESTIMATES for the MANUFACTURE and DELIVERY of a MECHANICALLY PROPELLED APPARATUS for CLEANING the INTERIOR SURFACE of the new MERSEY VEHICULAR TUNNEL.

In the main Tunnel the width of the carriageway is 36ft. and is 1ft. 6in. below the axis of a semi-circular arch of 22ft. radius.

In the branch Tunnels the width of the carriageway is 19ft. and is 7ft. 3in. below the axis of a semi-circular arch of 13ft. 3in. radius.

The limiting headroom for vehicles entering the Tunnel is 16ft. 6in.

Estimates, accompanied by specifications and drawings, must be sent THROUGH THE POST in a sealed envelope, endorsed "Estimate for Cleaning Apparatus," and addressed to the undersigned, so as to be delivered not later than 10 a.m. on Monday, 16th January, 1933.

WALTER MOON,
Clerk to the Mersey Tunnel Joint Committee.

Municipal Buildings, Liverpool,
25th October, 1932. 9100

Armourers' and Brasiers' Company in the City of London.

LECTURES IN METALLURGY.

The Company have arranged for a COURSE of THREE LECTURES to be delivered at the ROYAL SCHOOL of MINES, Prince Consort-road, South Kensington, at 5.30 p.m. on TUESDAYS, the 15th, 22nd, and 29th NOVEMBER, 1932, by Professor Sir HAROLD CARPENTER, F.R.S., M.A., Ph.D., on

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Please send your instructions with remittance early to ensure insertion.

CLASSIFIED ADVERTISEMENT DEPARTMENT,
"THE ENGINEER,"
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PUBLIC NOTICES.

Government of Northern Ireland.

APPOINTMENTS AS TEMPORARY ASSISTANT CIVIL ENGINEERS.

The Ministry of Finance invites APPLICATIONS for the undermentioned APPOINTMENTS as TEMPORARY ASSISTANT CIVIL ENGINEERS :

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(b) Junior and Senior Assistant Civil Engineers, with general experience in the Design and Execution of Civil Engineering Works.

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Candidates for Senior Appointments must be Corporate Members of the Institution of Civil Engineers, and for Junior Appointments must either have passed the Qualifying Examination for Associate Membership of the Institution of Civil Engineers, or have obtained an Engineering Degree recognised as giving exemption from parts A and B of this examination.

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The Engineer

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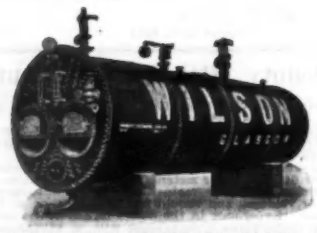

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The Duty on Copper.

In the House of Commons on Monday last, October 24th, during a discussion on the Ottawa agreements, Mr. Neville Chamberlain, the Chancellor of the Exchequer, admitted that the proposed duty on copper was a prohibitive duty; but it was accompanied by the express condition that Empire producers of copper, who were principally Canadians and Rhodesians, must be able to supply the needs of consumers in this country and at world prices. The question of ascertaining world prices was a difficult one; it had been discussed by those engaged in the trade, who were best fitted to hammer out a really workable plan. Both producers and consumers had been engaged in working out that question for several days in conference together. Part of the field had already been covered, and there was every reason to believe that an agreed conclusion would be received by the Government as to the way in which the matter was to be dealt with. When the Government had received that conclusion, all it would have to do would be to put it into operation. All the users of copper in this country would be able to get what they required from Empire sources at world prices.

A Steel Works Reorganisation Scheme.

An indication of the revival of activity in the British steel industry, which has taken place since the imposition of duties on imported iron and steel, is provided by the announcement that the board of directors of the Skinningrove Iron Company, Ltd., has taken over the active management of the Skinningrove Iron and Steel Works, and will carry out an important scheme of reorganisation and development. These works, it may be recalled, have been for some time past leased to Pease and Partners, Ltd. In order to enable the technical equipment to be reviewed, overhauled, and supplemented, where necessary, to meet the firm's new requirements, the manufacture of steel is to be suspended for some weeks. Rolling will cease on Saturday, November 5th, and it is expected that production will again be begun on Monday, March 6th, 1933. Meanwhile a large stock will be maintained so that customers may be inconvenienced as little as possible. The company, we learn, has retained the services of Mr. C. C. Atha, recently a managing director of Stewarts and Lloyds, Ltd., who will act as technical consultant. Mr. J. H. Skelton, late of H. J. Skelton and Co., Ltd., has been appointed to take charge of and to reorganise the sales department. The scheme of development decided upon is one, we are given to understand, which will enable the Skinningrove Works to play, in the future, an important part in the steel trade of the country under the new conditions which may be expected to follow the stabilisation of import duties for a period of two years.

The Aswan Power Scheme.

According to a Cairo message, the Egyptian Government will shortly invite tenders for the construction of a large hydro-electric power station, which is to be built at the western end of the Aswan barrage. The plant is to be designed to utilise the increased head which will be available when the work of heightening the dam is complete. That work, as recorded in a Journal note of December 5th last, is being carried out by Messrs. Topham, Jones and Railton, of London, the engineers being Sir Murdoch Macdonald and Partners, of Westminster. The power scheme, which is entirely separate from the work of heightening the dam, will, we learn, include four turbine-driven generators, each of 40,000 kW capacity. The work is to be financed by the Egyptian Government out of revenue, and will be one of the most important public utility works undertaken in Egypt during recent years. The power generated will principally be employed for the manufacture of nitro-chalk and other artificial manures, the surplus power being available for pumping and irrigation schemes in the Aswan and other provinces which now require more expensive oil fuel and coal. The power plant will, it is expected, require about four years to complete, but as the fertiliser plant can be finished in about two years, it will be begun at a correspondingly later date.

Proposed Scottish Gas Grid.

At a meeting of the Royal Scottish Society of Arts held on Monday last, under the chairmanship of Professor Henry Briggs, Mr. Robert Maclaurin, of Stirling, read a paper on "The Lothians Area and a Gas Grid for Scotland." The existence of the electricity grid, Mr. Maclaurin stated, did not mean that a gas grid was unnecessary. Twenty years ago the price of gas in Glasgow was 4d. per therm, a therm in electrical energy then being about seven times that price. The electrical industry was then using about 4,500,000 tons of coal per annum, and the gas industry over 16,000,000 tons. In twenty years the electrical industry had doubled its consumption of coal, and had quadrupled its output of energy. In the face of increasing costs for coal, labour, and material, the electrical industry had reduced the selling price per kilowatt in Glasgow by about 13 per cent. The gas industry was still carbonising only about the same weight of coal, with an increase in therms of about 15 per cent., but the selling price of gas per heat unit had almost doubled. The reason for this, Mr. Maclaurin stated, was that the inherited prejudices of the gas industry were many. After dealing with different aspects of economical production, Mr. Maclaurin stated that from estimates he had made, and estimates he had examined, he was satisfied that gas of any calorific value between 240 and 750 B.Th.U. could be made by carbonising coal at the pithead at a price varying from ¾d. to 1¼d. per therm. The various problems of distribution which arose in a scheme for the Lothians area were then discussed, and it was stated that an allowance of ¾d. per therm would amply meet all charges under this heading.

The New Swansea Power Station.

More than usual interest attaches to the large contract which has just been placed with International Combustion, Ltd., of London and Derby, for the Tir John North power station of the Swansea Corporation electricity department. The contract, which amounts to close upon £250,000, represents one of the largest boiler orders placed in this country for some time, and it also marks an entirely new departure from previous large boiler practice in this country, as the fuel to be burned in pulverised form is anthracite duff, a hitherto practically unmarketable fuel, with only 6 to 8 per cent. volatile content. The successful use of this fuel will, it is felt, most probably have an important bearing on the future of the Welsh anthracite coalfield. There are to be four boilers, each of 240,000 lb. per hour normal and 280,000 lb. per hour peak load steam capacity, which will work at 625 lb. pressure, with a final steam temperature of 850 deg. Fah., the feed water being supplied at 350 deg. Fah. The boiler construction will be carried out by Combustion Steam Generator, Ltd., a subsidiary company of International Combustion, Ltd., and the Lopulco storage principle of burning pulverised fuel will be adopted in conjunction with four Hardinge mills, each of 10 tons per hour capacity. Preheated air at 700 deg. Fah. will be supplied to the furnaces. The order for the two 30,000-kW turbo-alternators has been placed with C. A. Parsons and Co., Ltd., of Heaton Works, Newcastle-upon-Tyne, and the current will be generated directly at 33,000 volts, thus avoiding the necessity for step-up transformers.

An Anglo-Indian Steel Agreement.

Further details are now available with regard to the supplementary agreement made between British and Indian galvanised steel sheet manufacturers since the close of the Ottawa Conference, where discussions were first initiated. The agreement principally concerns the Tata Iron and Steel Company, of Jamshedpur, India, and Mr. James Whitley, of the Oriental Steel Company, and provides for the imposition of the following duties in India:—R. 30 per ton on United Kingdom sheets made from Indian semi-finished material; R. 53 per ton on United Kingdom sheets made from any other material; and R. 83 per ton on foreign sheets. The Tata Company will make galvanised sheets for those portions of the market which it is most economically situated to supply, the remainder being supplied by British firms. Two years ago British exporters were supplying 300,000 tons of galvanised steel sheets a year to India, and the normal requirements were increasing by about 10,000 tons annually. To-day, owing to the trade depression, Indian imports have fallen to about one-third the former total, but it is hoped that on the ratification by the Indian Legislature of the agreement referred to, the preferential duty will enable British exporters to supply all India's imports, including about 75,000 tons now exported by Belgian firms.

Iron and Steel Import Duties.

In the White Paper, Cmd. 4181, published by His Majesty's Stationery Office, particulars are set forth as to the recommendations of the Import Duties Advisory Committee concerning the duties to be imposed on imported iron and steel. The paper also includes the first report of the National Committee for the Iron and Steel Industry to the Import Duties Advisory Committee and the Treasury Statutory Rules and Orders. The Advisory Committee refers to its first report of April 8th, and its reasons for its recommending a temporary duty of 33⅓ per cent. on a wide range of iron and steel products, which was duly effected by a Treasury Order of April 19th, and since extended as a temporary duty until October 25th, in order that the position might be reviewed at an early date. Dealing with the report of the National Committee of the Iron and Steel Industry, the Advisory Committee admits the recent serious differences between the prices of imported and home-produced iron and steel, and the difficulties outside the National Committee's control, which have delayed the completion of a satisfactory scheme of reorganisation. With a view to putting an end to the dumping of foreign steel, the National Committee suggested that the present duty of 33⅓ per cent. should be increased in a limited number of cases, and that the duties should be extended for at least two years. The Advisory Committee merely recommends that the duties as now applied should be continued for a further period of not less than two years from October 25th, 1932, subject to satisfactory progress being made in the preparation of a scheme of reorganisation and in putting the approved scheme into force.

Safety in Industry.

An interesting address on "Advantages of Voluntary as Against Compulsory Arrangements for Accident Prevention in Industry" was given on Friday last, October 21st, by Mr. John A. Gregorson to the Tees-side Industrial "Safety" Committee at Middlesbrough. After paying a just tribute to our code of factory legislation and its efficient inspectorate, Mr. Gregorson went on to say that as a nation we preferred the voluntary to the compulsory principle. Proof of the advantages of the voluntary principle, if such were needed, was to be found in the reports of the Chief Inspector of Factories. Thus, in the 1926 report it was stated that out of a total of 139,963 accidents reported only 34,833 were machinery accidents and the remaining 105,130 had nothing to do with machinery at all. This fact was too often overlooked. Mere lip service to the "Safety First" movement would not produce results. In order to do this some "safety" organisation on a voluntary basis must be established. In short, at every works some routine system must be set up and kept alive. If this were to be done, continued Mr. Gregorson, and constant enthusiasm and vigilance maintained, it was not too much to say that the diminution of accidents from year to year would be definite and perceptible. It would be a mistake, he thought, to attempt to impose upon industry any stereotyped system of accident prevention. Conditions, it might be said, varied from industry to industry and works to works. Some system was essential, but it was desirable to allow each firm to decide upon the nature of the system best suited to its individual works.

Large Synchronous Motor for India.

The transportation of the large synchronous motor, described elsewhere in this issue, from Rugby to the London Docks, ready for shipment to India, affords another example of the efficiency of British railways in dealing with heavy and cumbersome loads. In the construction of the machine the matter of transport, naturally, had to be taken into account, and the stationary and moving elements were designed so that they could be sent in two parts. The bottom half of the stator, measuring approximately 30ft. by 14ft. by 6ft., weighed nearly 27 tons and when loaded overhung the side of the truck by 3½ft. towards the 6ft. way. The special L.M.S. train left Rugby at midday, Sunday, October 23rd, and travelled *vid* Allesthorpe, Wigston Junction, Market Harborough, Wellingborough, Bedford, and the Midland main line to London *vid* Carlton-road Junction, Crouch End, and South Tottenham, thence by the L. and N.E. line *vid* Stratford Market to Victoria Docks. Not only was the adjoining railway track blocked from Rugby to London, but at one of the London stations the rails had to be slewed 12in. for a distance of 40 yards in order to enable the trucks to clear fixed structures. The two parts of the stator frame are being dealt with at the London end by the 50-ton Port of London Authority Victoria Dock crane, the consignment being lifted into the British India steamer "Mandala," which sails on October 29th and is due to arrive in Calcutta on December 1st. The remainder of the material, weighing roughly 114 tons, is being shipped from Birkenhead on the same date by the s.s. "City of Calcutta."

Manchester Aerodrome Wireless Station.

On behalf of the Air Ministry the Marconi Company is about to erect a wireless station at the Manchester Corporation aerodrome at Barton Moss. It will be the first fully equipped wireless station to be erected at a municipal air port for the use of civil aviation services, and a meteorological office for the issue of weather reports will be established simultaneously. Sufficient power will be available at the station to establish communication with aircraft making the Irish Sea crossing to Belfast or Dublin and to cover a wide area of North-West England and Wales and the Midlands. Various classes of wireless service that have proved to be of value to aviation will be provided, including ground to air communication by telephone or telegraph, meteorological broadcasts, wireless direction finding and inter-aerodrome services. In order to avoid any possible danger to aircraft using the aerodrome the transmitting station with its 100ft. aerial masts will be erected some little distance from the aerodrome, but it will be operated from a control room at the aerodrome. The 3-kW transmitter will be designed to operate on wave-lengths between 700 m. and 1550 m., which include all the medium wave-lengths allotted by international convention for civil aircraft communications.

Reinforced Concrete Pole Design.

By WILLIAM T. TAYLOR, M. Inst. C.E., M.I.E.E., &c.

The need for a wood-pole substitute is being felt because of the increased use of overhead lines and greater demands for, and increasing cost of, suitable wood for poles, and growing desire for a more permanent type of construction offering either greatly reduced or a total absence of annual maintenance costs. The modern overhead line demands that pole fittings obviate bird troubles, and the poles offer high strength with long life and low total annual costs. Overhead lines demand minimum gross construction costs per mile of line rather than relative cost of poles, and least total annual expenses during the life of the line rather than the life of the pole only.

When buying a pole, or when computing the cost of a pole line, the requirement is not merely that of buying one kind of pole (wood, steel or concrete) at less cost than another, or, that one kind of pole line can be built at less cost than another. The most economical pole line is that one able to transmit the most power for the least cost spread over the life of the line (not life of the pole), *i.e.*, transmit the most power for the least price at all times. This involves the initial cost of the pole line and the annual amounts chargeable to capital interest, and ever afterwards, the maintenance and renewal costs, depreciation annuities, sinking fund, and equitable charges for service interruptions which, though uncertain, should be included as extraordinary annual charges caused partly by the type of pole, &c., adopted. The ideally designed pole line of given strength and pleasing appearance is that obtained at the least price and capable of maintaining maximum strength for the longest term of years with minimum annual costs for maintenance, interruptions, &c., during the life of the line.

Compared with a wood pole (in use, or once used) which decreases in strength from year to year, due to the increasingly perishing wood-fibre occupying the greater circumferential area, the reinforced concrete pole should normally become stronger with age and be almost free from maintenance costs. Seeing that an electricity undertaking can make its own poles any time and anywhere (particularly at danger points, at terminals, in inaccessible places, &c.), transportation, haulage, scaffolding, and costs due to replacements or weaknesses, &c., can be cancelled out and a highly satisfactory minimum-cost, longest-life construction can be made.

Three outstanding advantages of the reinforced concrete pole are high strength, durability, and almost total absence of maintenance costs. And the advantage of first cost may also be claimed for many overhead lines which is made possible by a method of manufacturing the pole right in the line itself. Independent of advantage gained by this form of manufacture, it should be borne in mind that the strength of a reinforced concrete pole depends largely on the quality of composite materials used, the steel reinforcement, the curing and other important conditions. The strength is influenced by the shape of the pole, the cutting out of concrete section not specially reinforced, the condition of the cement and aggregates, the condition, quality and disposition of the steel reinforcement, the richness of the mixture, consistency, &c. And the actual strength for present-day common methods of manufacturing and erecting depends in no small way on the treatment during transportation, haulage and handling from the time the pole is made to the time it is set in its final position in the line.

For a wood pole the fibre stress is fixed at one value for each class of timber, *i.e.*, for red fir $f_w = 7800$ lb. per square inch. With wood we deal with one material only, and the usual design problem is to find the diameter of the pole after assuming or calculating the moment. That is:

$$M = \frac{f_w \pi d^3}{384} \text{ (ft.-lb.), and } d = \sqrt[3]{\frac{M\,122{\cdot}4}{f_w}} \text{ (inch).}$$

In the case of reinforced concrete the first step is to assume unit stresses for the concrete and the steel, and a value for the modulus ratio. The involved components such as position of neutral axis, lever arm of stress couple, &c., are then calculated. For reinforced concrete we deal with two distinct materials offering variable unit stresses and component values, and before we can arrive at the resisting moments to be developed for a given concrete section and steel reinforcement we must first know the respective component values for changing areas of steel and concrete. The ratio modulus of elasticity of steel to that of concrete varies from 10 to 15, according to the straight line theory, but according to the secant modulus theory, which is somewhat nearer exact conditions, it varies from 8 to 12.

Steel is manufactured under standardised and uniform conditions, and variation in the elastic limit and ultimate strength for each grade of steel is very slight. On the other hand, the quality and manufacture of concrete as well as the characteristics and strength of the composite materials vary widely, so that the quality of cement and ultimate strength of the manufactured concrete may vary from good to bad. We are thus dealing with two distinct materials, one of which varies widely in strength, due to (*a*) characteristics of the materials composing it; (*b*) manufacturing and curing; (*c*) transportation and haulage of finished product; (*d*) general handling and final erection, the other material (steel) remaining practically unchanged and unaffected up to its yield point.

The ultimate strength of steel cannot be accepted as a true strength value upon which the factor of safety should be based. As a 55,000 lb. per square inch ultimate strength steel has an actual practical strength value no greater than $55{,}000 \times 0{\cdot}65 = 35{,}750$ lb. per square inch, we cannot safely get more than this latter value from it, and the factor of safety must be based on the elastic limit and yield point, otherwise we assume a false strength. The effective ultimate strength for concrete is around 75 per cent. of the maximum ultimate strength. Due to the many emergencies and contingencies, &c., covering such items as uncertain materials, workmanship, manufacture, hauling, transportation, handling, erection, &c., concrete should be given a relatively higher factor of safety than steel.

High steel stresses should go with large surfaces (and, consequently, large steel areas) to develop the necessary bond resistance. The actual bond strength will depend on the quality of the concrete and the condition of the surface of the steel, and actual stress on the steel will depend directly on the bond between the concrete and steel. These and other factors must be considered in establishing allowable stresses and the right factor of safety.

For ordinary reinforced concrete construction there is usually little or no difference made in the increase of steel stress for the usual range of rich and lean concrete mixtures. But the writer maintains that higher stresses should be allowed in direct proportion to the ultimate strength and richer mixtures, and that material saving in longitudinal steel can be obtained by increasing the steel stress along with that of the concrete. For best steel economy, the area of steel should be reduced when the external bending moment is less than the resisting moment of the balanced section, and when the balanced section is too strong, steel should be left out.

The density and consequent water-tightness of a concrete pole is quite as important as strength, and density may be taken as a measure of quality of concrete. If both the mix and consistency are considered as fixed and only the grading of the aggregates is allowed to vary, then the density should be a fair measure of the strength for, as the aggregate grading is changed to give greater density, the amount of water necessary to produce the required consistency is reduced, with a corresponding increase in strength and water-tightness. For a vertical cast pole kept in its wooden forms we can secure a dense weather-resisting surface because of the improved sealing of the concrete surface by preventing loss of original mixing water, a too sudden evaporation and elimination of hair-cracking and other surface cracking, and due to the mode of casting the vertical depth and the weight of plastic concrete, we also obtain greater density where the greater pole strength is required.

Elsewhere the tendency of modern reinforced concrete practice is rather to increase the steel stress, *i.e.*, reduce the factor of safety below that for exposed steel. There is, in reality, no reason for the demand that protected and supported steel of the same quality as unprotected and unsupported steel be subjected to the same factor of safety. Indeed, so far as reinforced concrete is concerned, it would be perfectly safe to use steel of ultimate strength far lower than the minimum allowable because the actual working stress is limited to $m f_c$ or m times the stress in the concrete $= 15 \times 600 = 9000$ lb. per square inch.

The steel ratio ρ depends on the selected stresses f_s and f_c, as also on the moduli ratio m. This moduli ratio and the compressive strength of concrete are not constant; the stronger the concrete, the lower the value of m, which latter increases as the aggregate becomes coarser, increases with age and richness of mixture and time of mixing. Value E_c for 1 : 2 : 4 stone concrete varies from 1,500,000 to 3,500,000, according to the different authorities on the subject. The value E_c increases at about the same rate as the ultimate strength of the concrete, but the actual stress in the steel remains about constant regardless of the concrete mixture, and its moduli E_s remains practically constant at from 29,000,000 to 30,000,000.

If we increase the richness of grade of concrete we also increase the moduli of the elasticity of concrete and decrease the ratio m; for equal strength ratio the steel ratio ρ and component values j, R and M/d^2 are also increased. For stone, gravel and selected slag concrete the customary value for $m = E_s/E = 30 \times 10^6/2 \times 10^6 = 15$. Safety is on the side of using $m = 15$ in preference to $m = 12$, because of the lower assumed value f_c for the equivalent values of f_s, ρ and R, according to the straight line theory. For fixed values of f_c and m, a decrease in f_s (or increase in the factor of safety for steel from 2·5 to 3·5) requires more steel with very slight gain in the moment M. If we increase the stress in steel for fixed value m, the amount of steel will be reduced, but if we increase the steel strength f_s and the moduli ratio m for fixed value f_c, the rate of steel increase will be more rapid.

The stress ratio f_s/f_c for fixed value m decreases with a corresponding increase in steel ratio ρ. For a decrease in m, with fixed ratio f_s/f_c, the steel ratio ρ is reduced sharply, *i.e.*, varying m from 30 to 10 will vary the steel ratio ρ from 0·0083 to 0·0042, or nearly one-half, and, fixing m at 15 and varying the stress ratio f_s/f_c from 40 to 10, increases the steel ratio from 0·0034 to 0·03, or nearly ten times—see Table I.

TABLE I.—*Constants for Reinforced Concrete Design.*
Where $f_s = 600$, $f_c = 16{,}000$, $m = 15$.

ρ.	k.	j.	f_c.	$\frac{f_s}{f_c}$	R.
0·0050	0·320	0·893	600 500	26·67 31·95	85·6 71·3
0·0052	0·325	0·892	600 513	26·67 31·21	86·8 74·2
0·0054	0·330	0·890	600 525	26·67 30·52	88·0 76·9
0·0056	0·334	0·889	600 534	26·67 29·86	89·2 79·6
0·0058	0·339	0·887	600 547	26·67 29·23	90·2 82·9
0·0060	0·344	0·885	600 550	26·67 28·64	91·3 85·0
0·0062	0·348	0·884	600 569	26·67 28·08	92·3 87·7
0·0064	0·353	0·882	600 581	26·67 27·54	93·4 90·3
0·0066	0·357	0·881	600 592	26·67 27·63	94·3 93·7
0·0067	0·358	0·881	600	26·67	94·5
0·0070	0·365	0·878	612	26·08	98·3
0·0073	0·367	0·877	624	25·63	100·3
0·0074	0·373	0·876	633	25·21	103·7
0·0076	0·377	0·874	645	24·80	106·3
0·0078	0·381	0·873	658	24·40	108·9
0·0080	0·384	0·872	664	24·02	111·5
0·0082	0·388	0·871	665	23·66	114·3
0·0084	0·392	0·869	687	23·31	116·8
0·0086	0·395	0·868	696	22·97	119·6
0·0088	0·399	0·867	708	22·64	122·2
0·0090	0·402	0·866	717	22·33	124·7
0·0092	0·405	0·865	730	22·02	127·3
0·0094	0·408	0·864	735	21·73	129·9
0·0096	0·412	0·863	747	21·66	133·8
0·0098	0·415	0·862	756	21·44	135·2
0·0100	0·418	0·861	766	20·89	137·8
0·0102	0·421	0·860	777	20·63	140·3
0·0104	0·424	0·859	785	20·38	142·9
0·0106	0·427	0·858	789	20·14	145·5
0·108	0·430	0·857	803	19·90	148·1
0·0110	0·433	0·856	804	19·67	150·7
0·0112	0·436	0·855	824	19·44	153·2
0·0114	0·438	0·854	829	19·22	155·8
0·0116	0·441	0·853	845	19·01	158·3
0·0118	0·444	0·852	850	18·80	160·4
0·0120	0·446	0·851	856	18·60	163·4
0·0122	0·449	0·850	868	18·40	165·9
0·0124	0·452	0·849	885	18·22	168·4
0·0126	0·454	0·849	887	18·02	171·0
0·0128	0·457	0·848	895	17·84	173·7
0·0130	0·459	0·847	905	17·66	176·2

For a fixed value ρ the ratio j decreases with increasing moduli ratio m, and for a fixed value of m the value j increases with decreasing steel ratio ρ. For fixed value of ρ, the ratio k increases with increasing moduli ratio m, and for fixed value m the value k decreases with increasing value of ρ. These relations are important in designing and they indicate the need for two distinct factors of safety for the two materials.

The steel and concrete stresses and their related components required for reinforced concrete pole designs are:

$f_c = 600$	f_s	14,000		16,000		18,000
	j	0·870		0·881		0·889
and	k	0·391		0·358		0·333
$m = 15$	ρ	0·0084		0·00675		0·0056
	R	102		94·5		88·9
$s = 16{,}000$	f_c	500	550	600	650	700
	j	0·894	0·887	0·881	0·874	0·868
and	k	0·319	0·339	0·358	0·379	0·397
$m = 15$	ρ	0·0050	0·0058	0·00675	0·0077	0·0087
	R	71·3	82·3	94·5	107·7	120·6

When the values f_s or f_s/m and values f_c or mf_c are drawn to a sufficiently large scale, value k can be found by drawing a diagonal line to intersect the centre line drawn through the section. For any position of k with fixed value f_c, the value f_s is found by drawing a diagonal line between the two points. Obviously, for fixed value k, if we overstress f_c we overstress f_s, and, if we fix the stress ratio f_s/f_c and decrease the value m, we decrease the steel ratio ρ.

According to the straight line theory, for equal strength (intermediate pole design) and double reinforcement where $f_s = 16{,}000$, $f_c = 600$ and $m = 15$,

$$\rho = \frac{m f_c}{f_s + m f_c} \cdot \frac{3 f_c}{6 f_c - 4 m f_c} = \frac{15 \times 600}{16{,}000 + 15 \times 600} \times \frac{3 \times 600}{6 \times 600 - 4 \times 15 \times 600} = 0{\cdot}0108$$

$$A_s = 0{\cdot}0108\, b\, d$$

$$M_s = f_s \left(\frac{f_s\, k\, (3 - k)}{6 f_s - 4 m f_c} \right) b\, d^2 = 600 \times 0{\cdot}2467\, b\, d^2 = 148\, b\, d^2.$$

For single reinforcement balanced steel ratio:

$$\rho = \frac{1}{\frac{2 f_s}{f_c}\left(m + \frac{f_s}{f_c}\right) - \rho\, m} = 0{\cdot}00675\,; \quad k = \sqrt{(\rho\, m)^2 + 2\,\rho\, m}$$

$$j = 1 - \frac{k}{3} = 0{\cdot}88\,; \quad f_c = \frac{2 \rho f_s}{k} = 600.$$

A quantity 2 is used for the variables ρ, j and f_c in the tabulated straight line values of Table I. For the secant modulus theory and same formulæ the quantity approximates 1·9 for $m = 9{\cdot}5$, $f_s = 600$ and $f_s = 16{,}000$. The respective calculated components ρ and j, for $f_s = M/\rho\, j\, b\, d^2$, must be used. For the straight line formula f_s is higher and f_c lower, k greater and j smaller than values given by the secant modulus formulæ. As we decrease the factor of safety for concrete of a given strength the calculated values ρ, k and f_c (not f_s) are affected because the value m is decreased. But, according to the straight line theory the steel stress will increase and value m will remain unchanged, hence the calculated design may

be more costly for a given factor of safety for steel when using the straight line formulæ.

The most economical concrete product $b\,d$ is dependent on the percentage of steel used, the ratio of cost of steel to cost of concrete per unit of volume, and other factors. Where the design is for a steel reinforcement less than the balanced or equal strength ratio there need be no change in the value $M=(k\,j/2)\,f_c\,b\,d^2$, whether $f_c=600$, or $f_c=700$ (see Table I.), because the steel stress value f_s will decide the safe resisting moment. Since the steel is a material we can rely on, and as it is the more expensive material and must be properly protected from the atmosphere for maintenance of its quality and strength, it is generally recognised as the safest, best, and most economical policy to develop the known full safe strength of the steel rather than attempt the rather uncertain full strength of the concrete. An equal factor of safety for both materials may be far from the balanced strength and most economic long-life design. With moduli ratio $m=15$ and $f_s=16{,}000$, according to the straight line theory, there is practically no difference in values R for steel ratios under 0·005, whether $f_c=650$ or 500. But above this steel ratio (balanced steel for $f_c=650$ and for $f_c=500$ ranging between 0·0043 and 0·00499) the differences between the R values for $f_c=650$ and $f_c=500$ suddenly change and vary widely up to about $p=0·0108$, changing but slightly afterwards. Economic design requires that both concrete and steel develop their maximum unit stresses at the same time under the particular load and that every section of the pole be of uniform factor of safety and strength. Inserting steel much above the balanced ratio means waste of strength and money.

The longest life for least total cost is usually secured where stresses are moderate, $b\,d$ high, full effective strength of both concrete and steel utilised, good quality concrete and steel used and high bond resistance maintained. For a given pole section the object is to secure the strongest bond with the most economical reinforcement, and it is usually more economical to increase the product $b\,d$ than the ratio p. A section with restricted concrete or steel may suffer from excess bond or shear stresses.

The solid type of pole shown in Fig. 1 is cheap, strong, and has a pleasing shape; there are no weak sections, no joints, and no gaps or reduction in the concrete section. The design is public property and it is easily manufactured by electricity undertaking engineers at home and abroad. The pole should preferably be cast vertically in its final position in the line without scaffolding or other equipment*; it can be satisfactorily cured in its wet wood-form, thus producing a pole of great density and water-tightness which are essential features for high strength and long life.

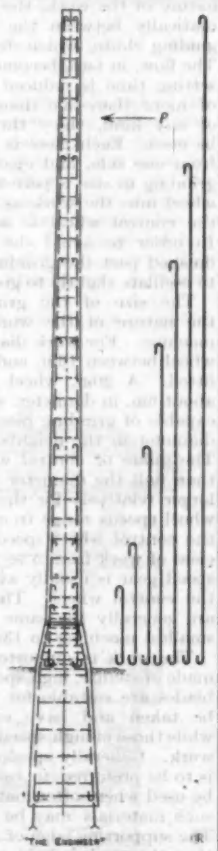


FIG. 1

As pole bending occurs the strain on one side is that due to the stress in the concrete, and the strain on the other side is that due to the stress in the steel, or an equivalent of f_s/m unit stress compared with f_c in the concrete—see Fig. 2. The horizontal pull P tending to bend the pole is resisted by the steel in tension and to a much lesser extent by the steel in compression on the opposite side of the pole; each concrete section also offers considerable resistance to the pull. The shear stress is taken care of by steel hoops secured at intervals to the longitudinal steel—see Fig. 1—particularly near and at base of pole.

When a pole is bent and equilibrium of forces exist, the external bending moment is just equal to and balanced by the internal resisting moment. In this condition the internal tensile stresses will just equal and balance the internal compression stresses, so that the total tension in steel should equal $f_s\,(A-A^1\,t)$, which is the amount to be balanced by compressive steel. For an intermediate pole the same amount of tensile steel is required on both sides of the pole, because the transverse design load is calculated as coming from both sides. However, where an excess of steel above the balanced ratio is used the maximum safe stress in the steel cannot be taken full advantage of.

As the height l of load application and the pull P are usually known in advance for any given span or location, the common problem is that of designing for a given maximum external bending moment M (inch-pounds), or pull P (foot-pounds), or (pound).

A pole taper is usually taken as $\frac{1}{6}$in. per foot of length; from this the $b\,d$ section for different pole heights is obtained.

The effective depth to centre of gravity of compressive steel, taken from the tension side, is given as:

d = overall pole thickness $-d^1$ (inch)

Depth from concrete surface to centre of steel is:

d^1 = concrete cover 1/2 rod diameter for single-row steel;

$=d''$ — distance to centroid of steel for two or more rows.

Overall sectional area of concrete $A_x=b\,(d+d')$ (square inch)

Sectional area of steel in tension (for balanced design) is:

$$A_e=p_e\,b\,d\;;\quad\therefore\quad p_e=\frac{A_e}{b\,d}$$

Steel stress in tension $=A_e\,f_s$ (lb. per square inch)

Concrete stress in compression $=1/2\,f_c\,k\,b\,d$ (lb. per square inch)

For the concrete $b\,d^2=\dfrac{M_e}{\frac{1}{2}\,f_c\,k\,j}$; for the steel, $b\,d^2=\dfrac{M_e}{f_s\,p_e\,j}$

Maximum resisting moment of pole reinforced with A_e steel is:

$$M_e=f_s\,(p_e\,b\,d)\,j\,d \qquad \text{(inch-pound)}$$

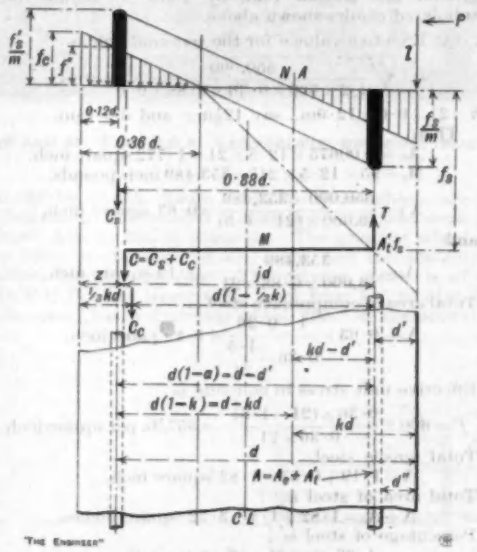
$$f_s\,p_e\,j=R\;;\quad M_e=R\,b\,d^2\quad\therefore\quad R=\frac{M_e}{b\,d^2}$$

and $$d=\sqrt{\frac{M_e}{R\,b}} \qquad \text{(inch)}$$

Where b equals $0·6\,d$,

$$M_e=R\,(0·6\,d)\,d^2\quad\therefore\quad d=\sqrt[3]{\frac{M_e}{0·6\,R}} \qquad \text{(inch)}$$

The moment that must be developed in excess



A_e Balanced ratio tensile steel area (sq. in.).
A'_t Required additional tensile steel area (sq. in.).
A Total tensile steel area (sq. in.).
C_c Compression stress in concrete (lb./sq. in.).
C_s Compression stress in steel (lb./sq. in.).
d' Distance from pole face to centre of steel in tension (in.).
d Distance from pole face to centre of steel in compression (in.).
d'' Distance from pole face to outer part of steel (in.)—cover.
f_c Unit stress in concrete (lb./sq. in.).
f' Unit stress in compressive steel (lb./sq. in.).
f_s Unit stress in tensile steel (lb./sq. in.).
$j\,d$ Lever arm of the couple $=d-z$ (in.).
k Ratio of depth of neutral axis of section below d (in.).
l Height of point of application of load (ft.).
M Bending or resisting moment (in.-lb.).
N A Neutral axis of the section of pole.
m E_s/E_c = moduli ratio.
P Externally applied load, top of pole (lb.).
T Total tensile stress in the steel (lb./sq. in.).
z Distance from pole face to the resultant compression on line of section $C=C_s+C_c$.

(For balanced steel section the values $j\,d=0·88\,d$, $k\,d=0·36\,d$, $1/3\,k\,d=0·12\,d$ are shown for convenience.)

FIG. 2—STRESS DIAGRAM OF POLE SECTION

of the compressive strength of the concrete is $M_c=M-M_e\quad\therefore M=M_c+M_e$ (inch-pound)

Also, M = moment due to pull on conductors + moment due to load on the pole (see Fig. 3).

Area of tensile steel required to provide sufficient tensile strength to fully develop the strength of the concrete is:

$$A_t=\frac{M-M_e}{f_s\,j\,d} \qquad \text{(square inch)}$$

Sectional area of additional steel in tension necessary to develop the moment M_c is:

$$A_t=\frac{M-M_e}{f_s\,(d-d')} \qquad \text{(square inch)}$$

Steel resisting couple is $d-d'$, or $d\,(1-a)=d\left(1-\dfrac{d'}{d}\right)$

So that resisting moment $M_c=A'_t\,f_s\,(d-d')$.

Total compressive steel area:

$$A_c=A'_t\,\frac{1-k}{k-\frac{d'}{d}} \qquad \text{(square inch)}$$

and effective unit stress in the compressive steel:

$$f'=f_c\,(m-1)\,\frac{k\,(d-d')}{k\,d} \qquad \text{(lb. per square inch)}$$

The compressive unit stress in concrete at the centre of gravity of compressive steel is $f''=f'/(m-1)$ (lb. per square inch)

Total tensile steel reinforcement on each side of straight-line pole is:

$$A=p_e\,bd+\frac{M_c}{f_s\,(d-d')} \qquad \text{(square inch)}$$

Total area of steel reinforcement for the intermediate (straight line) pole section is 2 A. For A and A_e see Table II. for size and number of steel

TABLE II.—*Standard Steel (Round) Rod Sizes and Areas.*

Size of rod, inch.	Area of rod, square inch.	Diameter of rod, inch.	Perimeter of rod, inch.	Weight of rod, lb.
1·0	0·7854	1·000	3·1416	2·67
15/16	0·6903	0·9375	2·9450	2·35
7/8	0·6013	0·875	2·7490	2·04
13/16	0·5185	0·8125	2·5530	1·76
3/4	0·4418	0·750	2·3560	1·50
11/16	0·3712	0·6875	2·1600	1·26
5/8	0·3068	0·6250	1·9670	1·04
9/16	0·2485	0·5625	1·7670	0·85
1/2	0·1963	0·5000	1·5710	0·67
7/16	0·1503	0·4375	1·3740	0·51
3/9	0·1104	0·3750	1·1780	0·38
5/16	0·0767	0·3125	0·9820	0·26
1/4	0·0491	0·2500	0·7854	0·17

rods. For the tension side of a terminal or dead-end pole the required tensile steel is $A=A_e+A'_t$, and the total steel is $A+A_e$.

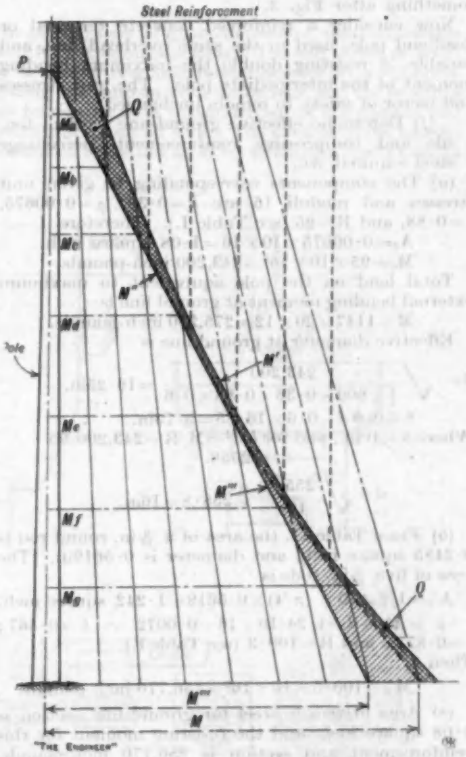
The area of compressive steel required on the compression side of a terminal or dead-end pole to develop the moment M_e is:

$$A_c=\frac{M_c}{f'\,(d-d')} \qquad \text{(square inch)}$$

and, in terms of area of extra tensile steel required to develop the same moment,

$$A_c=A'_t\,\frac{1-k}{k-a}. \qquad \text{(square inch)}$$

Let us now consider a straight line reinforced



M = Maximum external bending moment
= Bending moment due to horizontal pull on wires + bending moment due to wind load on pole itself.
M′ = Moments curve for concrete section.
M″ = Moments curve for steel reinforcement.
M‴ = Total bending moment due to horizontal pull on all conductors.
Q = Excess bending moments of concrete section over steel reinforcement, which may be reversed as desired for most part.
M_a . . . M_g = Respective points of reduced steel reinforcement and bending moments for steel and concrete calculated (or tabulated) as shown for example (d).

NOTE.—Excessive concrete at and near top of pole is due to large minimum restricted section, and excessive concrete section near and at ground line is due to the need for higher factor of safety where abuses are more likely to occur.

FIG. 3—BENDING MOMENTS DIAGRAM

concrete pole required to resist a total horizontal transverse pull and pole load of 1147 lb.; the height of load application above ground line is 20ft. The

* See page 232, "Transformer Systems and Their Operation," by W. T. Taylor.

pole is to be rectangular in shape, so that $b=0\cdot6\,d$. Specification calls for a pole with effective ground-line section 10in. by 16in., unit stresses $f_c=600$, $f_s=16{,}000$, with $m=15$, safety factor of 3·5 for both materials, and concrete cover over reinforcement not less than $\frac{3}{4}$in.

(*a*) Determine effective concrete section and tensile steel required, resisting moment, and maximum bending moment at ground line.

(*b*) Determine steel area and moments developed when five $\frac{3}{16}$in. round steel longitudinal rods are inserted on the tension and compressive sides respectively at ground line.

(*c*) Determine effective compressive unit stress in steel, total steel area, and percentage steel required at ground line.

(*d*) Calculate and tabulate design values for different pole sizes; alternately, determine steel reinforcement, &c., for different sections of the same pole.

(*e*) Calculate and tabulate values for ground-line section of the pole under review for steel strength based on $F_s=3\cdot5$ and unit stresses ranging from 14,000 lb. to 20,000 lb. per square inch.

Calculations should be made on designs varied so as to finally arrive at the best to suit local conditions, economy, and requirement; then a moments diagram based on steel and its position, respective moments, &c., should be drawn to take the form something after Fig. 3.

Now consider a reinforced concrete terminal or dead-end pole, used in the same overhead line, and capable of resisting double the maximum bending moment of the intermediate pole. The unit stresses and factor of safety to remain unchanged.

(*f*) Determine effective ground-line section, tensile and compressive reinforcement, percentage steel required, &c.

(*a*) The components corresponding to given unit stresses and moduli 15 are $k=0\cdot36$, $\rho=0\cdot00675$, $j=0\cdot88$, and $R=95$ (see Table I.). Therefore

$$A_c=0\cdot00675\times10\times16=1\cdot08 \text{ square inch.}$$
$$M_c=95\times10\times16^2=243{,}200 \text{ inch-pounds.}$$

Total load on the pole equivalent to maximum external bending moment at ground line is

$$M=1147\times20\times12=275{,}280 \text{ inch-pounds.}$$

Effective diameter at ground line is

$$d=\sqrt[3]{\frac{243{,}200}{\frac{1}{2}\times600\times0\cdot36\times0\cdot88\times0\cdot6}}=16\cdot25\text{in.}$$
$$b=0\cdot6\,d=0\cdot6\times16\cdot25=9\cdot75\text{in.}$$

Where $b=10$in., and for $b\,d^2=M/R=243{,}200/95=2558$.

$$d=\sqrt{\frac{2558}{10}}=\sqrt{258\cdot8}=16\text{in.}$$

(*b*) From Table II. the area of a $\frac{3}{16}$in. round rod is 0·2485 square inch. and diameter is 0·5619in. The area of five $\frac{3}{16}$in. rods is

$$A'_c=1/2\times10\times(\pi/4)\times0\cdot5619=1\cdot242 \text{ square inch.}$$

$\rho=A'_c/b\,d=1\cdot24/10\times16=0\cdot0072$ $\therefore$ $k=0\cdot367$; $j=0\cdot877$; and $R=100\cdot3$ (see Table I.).

Then

$$M'_c=100\cdot3\times10\times16^2=256{,}770 \text{ inch-pounds.}$$

(*c*) Area of tensile steel for ground-line section is 1·08 square inch, and the resisting moment for this reinforcement and section is 256,770 inch-pounds. But the moment that must be developed and provided for in excess of the compressive strength of the section at ground line is $M_c=275{,}000-243{,}200=31{,}800$ inch-pounds. And the area of steel necessary to develop this moment is

$$A'_t=\frac{31{,}800}{16{,}000\times(16-1\cdot25)}=0\cdot1348 \text{ square inch.}$$

Area of steel necessary to develop the moment M_c is

$$A_t=\frac{243{,}200}{16{,}000\times0\cdot88\times16}=1\cdot08 \text{ square inch.}$$

Total tensile steel required for ground-line section is

$$A\dagger=1\cdot08+0\cdot1348=1\cdot215 \text{ square inch,}$$

which is equivalent to a total sectional area slightly greater than five $\frac{3}{16}$in. round rods or $5\times0\cdot2485=1\cdot2425$ square inch. And it is less than the nearest standard size of $\frac{7}{8}$in. round rods or $5\times0\cdot3068=1\cdot534$ square inch. Total steel required for the section is $2\times1\cdot215=2\cdot43$ square inches, or 1·49 per cent. steel reinforcement for effective section.

The effective unit stress in concrete at ground line is

$$f''=600\times\frac{0\cdot36\times(16-1\cdot25)}{0\cdot36\times16}=553 \text{ lb. per square inch}$$

and the effective compressive unit stress in steel at same point is

$$f'=553\times15-1=7744 \text{ lb. per square inch,}$$

or a value much less than the stress at the concrete surface, i.e., $m\,f_c=15\times600=9000$ lb. per square inch.

(*d*) Based on the unit stresses given above, we obtain the following for different pole sections or for a pole with b d dimensions varying as shown :—

Example (*d*).

b.	d.	A_c.	d'.	A'_t.	A_c.	f''.	f'.	A.	% A.	M_c.	M.
6	10	0·405	1·0	0·038	0·093	540	7,560	0·443	1·47	40,500	46,000
6½	11	0·483	1·0	0·0438	0·104	545	7,620	0·527	1·47	53,000	60,000
7	12	0·567	1·0	0·053	0·122	550	7,700	0·62	1·47	68,000	77,360
7½	12½	0·632	1·0	0·060	0·142	552	7,730	0·692	1·47	79,000	90,000
7½	13	0·68	1·0	0·063	0·144	554	7,760	0·743	1·47	88,350	100,450
8½	14	0·803	1·0	0·074	0·164	557	8,080	0·877	1·47	112,460	127,870
9	15	0·909	1·25	0·086	0·209	552	7,730	0·995	1·47	136,690	155,500
10	16	1·08	1·25	0·135	0·307	553	7,740	1·22	1·47	243,200	275,000

Example (*e*).

f_s.	F_s/s.	k.	j.	ρ.	R	A'_t.	2 A.	2 A%.	M_c.	M_c.	M.
14,000	49,000	0·391	0·87	0·0085	102	0·067	2·72	1·70	261,100	13,900	275,000
16,000	56,000	0·36	0·88	0·00675	95	0·1348	2·43	1·49	243,200	31,800	275,000
18,000	63,000	0·333	0·889	0·0056	88·9	0·175	1·79	1·12	228,580	46,420	275,000
20,000	70,000	0·311	0·897	0·0047	83·7	0·207	1·49	0·95	214,270	60,730	275,000

Obviously, the section 6in. by 10in. is good for M=46,000; M is only $1147\times12=13{,}764$, 20ft. above ground line.

(*e*) Based on a change of steel unit stresses from 14,000 lb. to 20,000 lb. per square inch, or the equivalent for steel of a changed factor of safety for ground line section 10in. by 16in., we obtain the tabulated results shown above.

(*f*) Effective value d for the terminal pole is

$$d=\sqrt[3]{\frac{550{,}000}{1/2\times600\times0\cdot36\times0\cdot88\times0\cdot6}}=21\text{in.}$$

$b=21\times0\cdot6=12\cdot6$in., say $12\frac{1}{2}$in.; and $d'=1\frac{1}{4}$in.

Then

$$A_c=0\cdot00675\times12\cdot5\times21=1\cdot772 \text{ square inch.}$$
$$M_c=95\times12\cdot5\times21^2=353{,}489 \text{ inch-pounds.}$$

$$A'_t=\frac{550{,}000-353{,}489}{16{,}000\times(21-1\cdot5)}=0\cdot63 \text{ square inch,}$$

and

$$A_t=\frac{353{,}489}{16{,}000\times0\cdot88\times21}=1\cdot19 \text{ square inch.}$$

Total area of compressive steel is

$$A_c=0\cdot63\times\frac{1-0\cdot36}{0\cdot36-\frac{1\cdot5}{21}}=1\cdot4 \text{ square inch.}$$

Effective unit stress in concrete is

$$f''=600\times\frac{0\cdot36\times(21-1\cdot5)}{0\cdot36\times21}=557 \text{ lb. per square inch.}$$

Total tensile steel

$$A=1\cdot19+0\cdot63=1\cdot82 \text{ square inch.}$$

Total area of steel is

$$A+A_c=1\cdot82+1\cdot4=3\cdot22 \text{ square inches.}$$

Percentage of steel is

1·23 over the effective section.

Simplified Method.

Knowing the unit stresses and the related components we may proceed either by ordinary proportion or by measurements from a stress diagram drawn to large scale. Total tensile steel area is given by $A=M/f_s j\,d$, where M is the external bending moment to be resisted, tension in the steel is $A\,f_s$, and compression stress the section is capable of resisting is $\frac{1}{2}f_c k\,b\,d$. The excess stress taken by compression is the difference between these two latter. The effective compression stress f'' (see Fig. 2) is $f_c\,(k\,d-d)/k\,d$, and stress in the compressive steel is $f'=f''(m-1)$. Area of compressive steel is $A_c=f_z/f'$ or $A'_t\frac{1-k}{k-a}$.

Solving above problem for the intermediate pole and ground-line section, where M=275,000 inch-pounds, $d=16$in., $d'=1\cdot25$in., &c., we have

$$A=\frac{275{,}000}{16{,}000\times0\cdot88\times16}=1\cdot215 \text{ square inch (as before)}$$
$$A'_t=A-A_t=1\cdot215-1\cdot08=0\cdot135 \text{ square inch.}$$

And for the terminal pole, where M=550,000 inch-pounds at ground line, $d=21$in., $d'=1\cdot5$in., &c., we have

$$A=\frac{550{,}000}{16{,}000\times0\cdot88\times21}=1\cdot84 \text{ square inch (as before),}$$
$$A'_t=1\cdot84-1\cdot19=0\cdot63 \text{ square inch (as before),}$$
$$A_c=0\cdot63\times2\cdot21=1\cdot393 \text{ square inch.}$$

As already shown, for balanced steel ratio, $A_c=\rho\,b\,d$. However, the actual steel area A_t required to provide sufficient tensile resistance to develop fully the strength of the concrete is $M_c/f_s j\,d$, since the actual resisting moment of the tensile steel equals $A_t f_s j\,d$. This, therefore, offers a reason for basing total tensile steel on the sum total steel areas $A_t+A'_t$ instead of $A_c+A'_t$, which latter usually allows greater tensile reinforcement.

† Some designers give $A=A_t+A'_t$ = total tensile steel.

Precision Grinding Machines.

No. VI.*

CENTRELESS GRINDING.

While the output capacity of a grinding machine may be very high, it is reduced for many jobs by the necessity for removing the finished article and se ting up the next. However this latter operation is performed on the ordinary external grinding machine, whether between centres, in a chuck, or in any other way, time that might have been employed for the actual grinding of the piece is wasted. The increase of production that can be brought about by reducing the setting time is responsible for the many devices, some of a costly nature, installed on external grinding machines which automatically set the work in the correct grinding position. In addition, the ordinary external cylindrical machine is not entirely suitable for grinding bars, although, by an arrangement of work supports after the style of those used in centreless machines, such work can be performed if external means are provided for rotating the bar.

The desire to increase production by reducing the setting time was, to a large extent, responsible for the development of the centreless grinder. The essential parts of such a machine are two grinding wheels, one of which is usually larger in diameter than the other, placed with their axes parallel or nearly parallel, and a work support situated between the two wheel faces. The work is held in position by the support, rotated by the smaller wheel, and ground to size by the larger. It need only be introduced between the wheels, no other centreing being required, and consequently the actual machining time is very little less than the total time taken to set up and grind the piece to size.

Two methods of operation are available according to the nature of the parts being ground. Bars, rods, ball-race rings, pins, &c., which are of the same diameter throughout can be fed continuously between the wheels entering on one side and being ejected at the other. This method is known as "through-feed" grinding, and the feed is applied by tilting the axis of the control wheel from the horizontal. By the use of suitable attachments, depending upon the nature of the work, the pieces may be guided automatically between the wheels and ejected into a guiding chute, which delivers them to a receptacle. The flow, in fact, becomes continuous and the loss in setting time is reduced almost to zero. For work of more than one diameter, and shouldered work of any kind, the "through-feed" method cannot be used. Each piece is inserted between the wheels from one side, and ejected on the same side. The grinding to size is performed by feeding the grinding wheel into the work as in plunge cut grinding, and the control wheel is set with its axis horizontal. In order to avoid the formation of rings on the finished part the grinding wheel is sometimes made to oscillate slightly to give the work a very fine finish.

The size of the grinding wheel depends upon the nature of the work to be performed by the machine. For work diameters up to 3in. a grinding wheel between 16in. and 18in. in diameter is usually fitted. A 20in. wheel is suitable for work up to about 6in. in diameter, while on the largest machines capable of grinding pieces 10in. in diameter a wheel diameter in the neighbourhood of 26in. is required. The guide or control wheel is usually rather more than half the diameter of the grinding wheel, being larger relatively for the bigger machines. Grinding wheel speeds range from 1000 to 2000 r.p.m., while the control wheel speed can be altered to suit the class of work from 5 to 300 r.p.m. A specially high-speed gear is usually available for use when trueing the control wheel. The widths of the two wheels are generally the same and range from 3in. in the smallest machines to 13in. in the largest.

The work is supported by a blade which may be made of stellite, high-speed steel, or cast iron. Stellite blades are suitable for use when heavy cuts are to be taken and have excellent wearing properties, while those of high-speed steel are suitable for ordinary work. Generally speaking, either of these materials is to be preferred to cast iron, which, however, may be used when softer materials are to be ground, since such materials may be scored by the harder blades. The supporting edge of the plate is cut at an angle so that the work is held against the control wheel, and the correct angle for the class of work being performed must be chosen. When wide wheels and a long blade are in use too great an angle is likely to set up chatter. Commonly used angles are 40 deg. against 4in. wheels, and 20 deg. to 30 deg. for wheel widths up to 8in. Practice has also shown that it is advisable to use a smaller angle the larger the diameter of the work. Naturally, the thickness of the blade is made as large as possible to obtain lateral strength, and is generally but slightly narrower than the work diameter for small parts. The position relative to the wheels at which grinding takes place depends upon the dimensions of the piece and the type of operation. In general, work should be ground above the centre line of the wheels, but long bars are usually fed through beneath the wheels in order to eliminate any whipping or chattering that might

* No. V. appeared October 21st.

be caused by irregular straightening. As far as ordinary small jobs are concerned, the centre of the work is usually placed distant by about half its diameter above the centre line of the wheels. Larger work is placed lower relatively, since grinding too high up on the wheels may cause chatter, owing to the wedging action of the wheels forcing the work upwards and out of contact with the work guide. Chatter may also be caused by an out-of-balance wheel.

Although the main limitation of the capacity of a centreless grinding machine is the diameter of the work to be ground, it is important to realise that weight also has an effect in reducing the diameter or length of bars which can be ground. For instance, a machine capable of taking diameters up to 3in. might be incapable of grinding a solid 2in. diameter bar 30in. long owing to the fact that it was too heavy for the control wheel to turn. The range for bar work can, however, be extended by supporting the pieces in specially designed attachments in which the bar rotates on rollers.

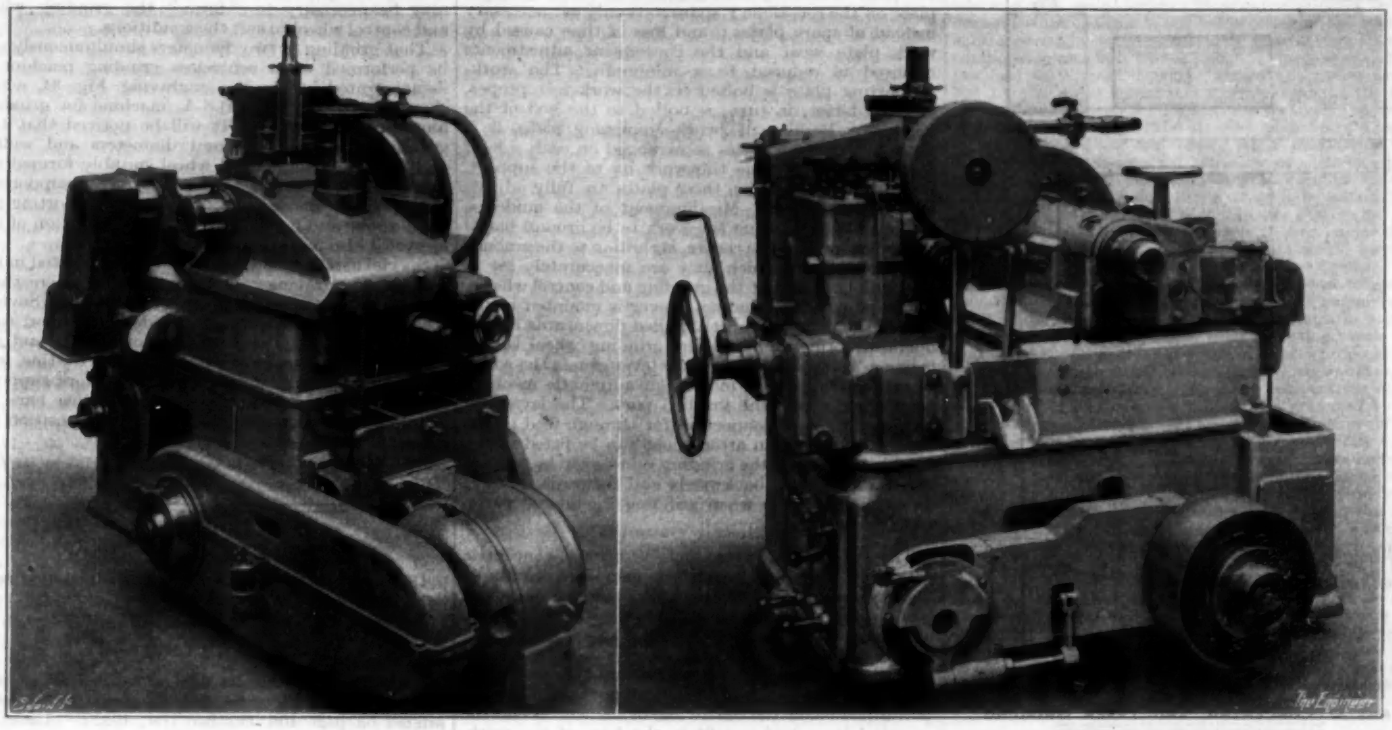
Owing to the fact that the work is not mounted on centres or in a chuck, centreless grinding machines are capable of dealing with work, the grinding allowance for which is appreciably less than on the ordinary grinding tool. A very usual allowance is 0·008in. to 0·010in., and certain classes of work can be ground to closer limits on centreless machines than on ordinary grinders. A tolerance of 0·0002in. is quite usual for general work and may be much reduced for special jobs, such as the rollers for roller bearings.

Centreless grinders are extensively used for grinding bar up to 2¼in. in diameter prior to machining. Since, on suitable machines, bars up to 12ft. long can be ground to a tolerance of plus or minus 0·00025, less trouble is subsequently experienced with automatic collets and other feeding devices. Some manufacturers find it economical to buy black bar and pass it through a centreless grinder to remove scale rather than to purchase the more costly bright bar in the first place. For long bars of large diameter the supporting steadies are frequently power-driven.

A Typical Design.

In the engravings, Figs. 29 and 30, two machines made by B.S.A. Tools, Ltd., of Birmingham, are illustrated. The smaller of these tools will take work from $\frac{1}{16}$in. to 3in. in diameter. The grinding wheel is 18in. in diameter by 3in. wide, and the control wheel 9in. in diameter. The driving motor is of 10 B.H.P. The larger takes work from $\frac{1}{4}$in. to 5$\frac{1}{2}$in. diameter, has a grinding wheel 20in. in diameter, and a control wheel 12in. in diameter. The wheels may be either 4in. or 8in. wide, and the power of the driving motor should be 15 B.H.P. or 17½ B.H.P., according to the wheel width. In other respects the designs of the two machines are similar. The grinding wheel head is mounted on long V and flat slides, so arranged that at no time are they exposed. The coarse feed of the slide is operated by a feed screw and nut put into motion by a hand wheel. The fine feed is supplied by a hand wheel mounted on the top of the slide. A movement of the periphery of the dial below the hand wheel of not less than 1$\frac{1}{4}$in. gives a cut of 0·001in. This fine adjustment operates a worm wheel cut on the outside diameter of the coarse feed nut.

The grinding wheel spindle of the larger machine is shown at the top of the engraving, Fig. 31. It is carried on a heavy casting mounted on the slide. The bearings are of phosphor bronze, with adjustable pads for taking up the wear. The end thrust is taken by a double row ball race, mounted in a spherical seating to ensure an even thrust face, and the bearings are lubricated by a pump driven off the spindle and drawing from an oil well. The control wheel spindle illustrated below in Fig. 31 is carried on a heavy casting



Figs. 29 and 30—Two B.S.A. Centreless Grinding Machines

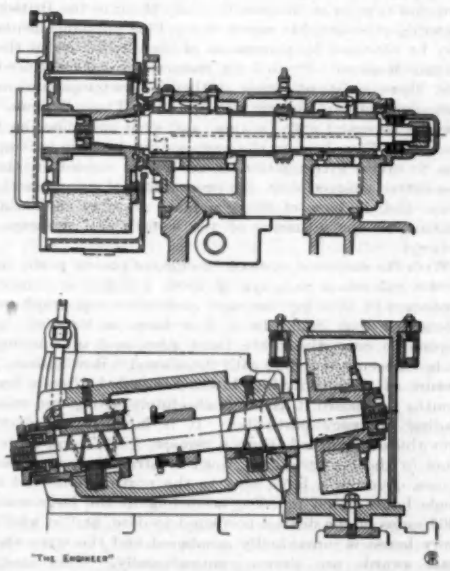


Fig. 31—Grinding and Control Wheel Spindles

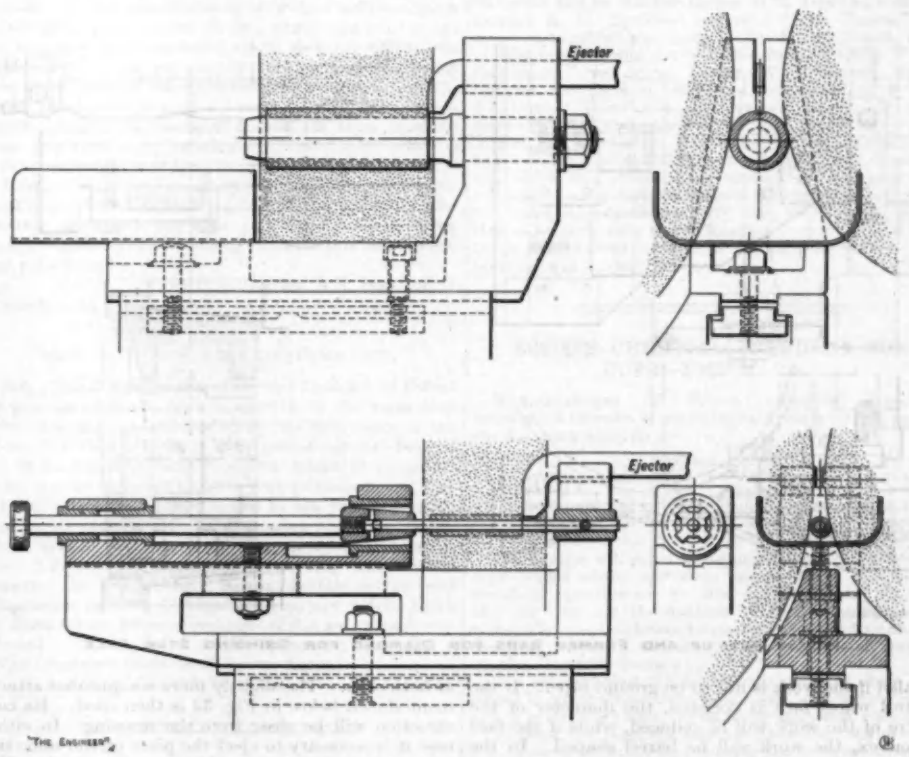


Fig. 32—Concentric Grinding Attachments

fixed to the bed of the machine, and its axis relative to that of the grinding wheel, is altered by the use of a screw and nut mechanism, to be seen at the left-hand end of the drawing. An external scale and pointer indicate the angular setting. The materials used in the construction of this spindle are the same as those used for the support of the grinding wheel.

The front bearing is taper and adjustable longitudinally, while the rear bearing is split, and both can be adjusted while the spindle is running.

In the large machine the control wheel is driven from the motor through a gear-box giving eight speeds ranging from 21 to 62 r.p.m., and an additional high speed for wheel dressing. The gear-box is bolted to a facing on the sub-base of the machine, and the change levers can be seen projecting outwards from the base in the engraving, Fig. 30. A top speed of

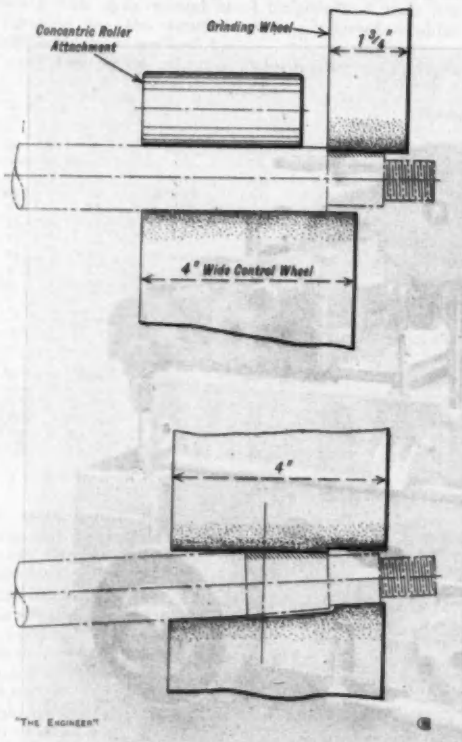


FIG. 33—CONCENTRIC AND TAPER GRINDING

450 r.p.m. for wheel dressing is put into operation independently of the gear levers by the use of a pedal at the front of the machine. The smaller machine has no gear-box, but by the use of simple pick-off gears within the base speeds from 23 to 76 r.p.m. can be given to the control wheel. A lever mounted on the base of the machine provides a quick change to the high speed required for wheel dressing—600 r.p.m.

It is of the greatest importance that the faces of the grinding and control wheels shall be dressed exactly parallel if the work is not to be ground taper. If the control wheel face is concave, the diameter of the centre of the work will be reduced, while if the face is convex, the work will be barrel shaped. In the B.S.A. machines the wheel-dressing slide is mounted on the casting that forms the control wheel guard. Both the guard and the attached slide are adjustable towards or away from the grinding wheel. Both wheels are dressed from the same slide. The diamond, having dressed the grinding wheel, is turned through 180 deg. for use on the control wheel. While in operation it is cooled by the abundant supply of water used when grinding. On the larger machine the diamond trueing slide is belt driven from the main gear-box drive through a flexible shaft to an automatic reversing box. It is put into operation by a pedal-operated clutch. For dressing formed wheels, a former of suitable shape is fixed between the slide and the bracket and the diamond holder moving along the longitudinal slide is kept in contact with the master former by means of a spring.

The work-supporting plate for ordinary work carries in a slot in its inclined face a long hardened rod. The makers claim that this construction has the advantages that when worn the rod can be turned round to several new positions; that regrinding of the plate is entirely eliminated, since the wear takes place on the rod alone; spare rods only are necessary instead of spare plates; and loss of time caused by work plate wear and the consequent adjustments required is reduced to a minimum. The work-supporting plate is bolted to the work rest proper, and the latter, in turn, is bolted to the bed of the machine. Besides the work-supporting plate, it is necessary to have plates so arranged on each side of the wheel as to guide the work on to the support. On the B.S.A. machine these plates are fully adjustable for alignment. Misalignment of the guides is responsible for causing the work to be ground barrel shaped or small at the centre, according to the amount and direction by which they are inaccurately set in line with the faces of the grinding and control wheels.

For plunge cut grinding a lever is mounted in the side of the machine, which, pulled downwards by the operator, brings forward the grinding wheel to the "sizing" stop. Release of the lever causes the wheel to return and sets in motion an automatic mechanism, which ejects the finished part. The lever can be thrown out of connection for through-feed grinding. If required, an attachment can be fitted to the machine, by which the grinding spindle can be reciprocated about $\frac{1}{8}$in. backwards and forwards, to give an extra fine finish when grinding shouldered parts.

Concentric Grinding.

The grinding of parts, such as bushes, concentric with the bore in a centreless grinder, presents at first sight obvious difficulties. In practice, however, such grinding can be done by the use of simple attachments, similar to those illustrated in Fig. 32. The first illustrates the grinding of a bush, of which the internal diameter is great enough to allow a stiff mandrel to be used as the sole support. Grinding is performed below the centre line of the wheels and the mandrel is a clearance fit in the bore of the work. On first advancing the grinding wheel, the piece is forced into contact with the control wheel. The point of support of the work on the mandrel then changes to a position intermediate between the vertical and horizontal lines through its centre, and on the grinding wheel side of the vertical. Continuation of the grinding operation will bring the point of support opposite the surface being ground, in which condition the exterior must be ground concentric with the interior. When the bush is of small diameter, it may be necessary to support the mandrel at both ends. The slightly more complicated attachment shown below in Fig. 32 is then used. Its construction will be clear from the drawing. In either case it is necessary to eject the piece on the same side as that upon which it entered between the wheels. This operation is performed automatically by the ejector when the grinding wheel is run back. The control wheel is frequently set over at a slight angle, such as 1 deg., for such operations, in order to keep the piece between the wheels and against the end of the ejector.

To grind two external diameters concentric against a shoulder, it is necessary to rearrange the grinding wheel. The operation is shown above in Fig. 33. A narrow grinding wheel of suitable width is mounted opposite one edge of the control wheel. The part is supported against the thrust of the grinding wheel by the control wheel, against which it is held by a supporting roller. The control wheel and roller abut against the larger diameter with which the smaller diameter is to be ground concentric.

The other engraving in Fig. 33 indicates how by the use of formed wheels tapers may be ground. If the taper occurs at the end of the shaft, or piece, it is only necessary to dress the control wheel at a suitable angle setting up the supporting bar parallel with the face; but when the shaft extends beyond the tapered portion, as shown in the illustration, it may be necessary to "form" the grinding wheel and control wheel to suit the conditions.

That grinding of two diameters simultaneously can be performed on a centreless grinding machine is demonstrated by the line engraving, Fig. 34, which shows the set-up on a B.S.A. machine for grinding motor car stub axles. It will be noticed that two grinding wheels of different diameters and widths and a single wide control wheel suitably formed are used. Instead of an ordinary type of supporting bar, specially shaped adjustable bars, supporting the work above and below, are used. The position of the ejector is also indicated on the drawing.

Special arrangements, such as those indicated in the last three engravings, are only justified where there is a large output of the particular article. Several machines are then arranged beside each other, each "set-up" to perform a separate operation, and the work travels from one to the next. In this way continual changing of the wheels and work-supporting rests, &c., is avoided, while the former bars for the diamond can remain permanently in position for dressing the wheels to the desired shapes.

(To be continued.)

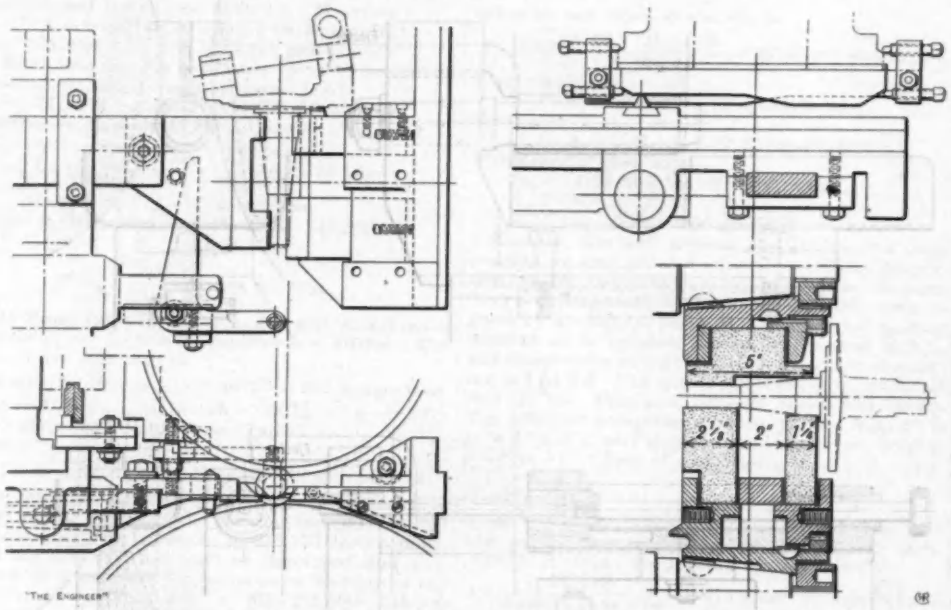


FIG. 34—SET-UP AND FORMER BARS FOR DIAMOND FOR GRINDING STUB AXLE

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

TREVITHICK CENTENARY.

SIR,—By an unfortunate slip, for which I ask pardon, I wrote at the end of the first paragraph of my letter printed on page 406, October 21st, 1932: "Later on, Tavistock-street and ultimately Tavistock-square," where the name in both places should have been "Torrington," as is obvious from the context in the following line: "The continuation of British Museum-avenue."

Your footnote to the letter, "Mr. King's views should be accepted with caution," ought to lead on to the examination of the real facts which are the only new ones of prime importance likely to emerge from the forthcoming commemorations. My "views" are that the old publications—the leading newspapers of London—which announced the first passenger railway demonstrations of 1808, are genuine; that they accurately and unmistakably indicated the sites of the 1808 railways for the guidance of intending visitors to the exhibitions; and that, taken altogether, they constitute the most extensive authentic record ever yet published concerning those railways. For those who have not time or inclination to study them in the British Museum, photographic copies of the 1808 announcements may be obtained by permission of the authorities of the British Museum. From long research, I am convinced that there exist no other authentic contemporaneous documents of this historic site of 1808. These "views" may be accepted with caution, and even suspicion, as I know they have been in the past, so my object in writing was to invite investigation of the prints named, by the Committee charged with the programme of commemorations, and, in view of fixing a plate or other memorial relating to the situation of the world's first passenger railways.

With the intention of determining the precise positions of the exhibition railways of 1808, I began and have continued to this day the most meticulous topographical researches that could have ever been undertaken by anyone to correctly locate these sites, and in starting, quite innocently, in 1925 with the alleged "Rowlandson" picture of the event, but I was compelled after a few months to discard it as being absolutely wrong and misleading in every particular. It is labelled "Richard Trevithick's Railroad, Euston Square, 1809," and represents in the background a town of straggling, irregular houses covering a large area to the north, where not a single house stood in 1808, according to the large-scale 1807 maps of the district corrected to date, and in which every house is individually numbered and the trees and grass swards are shown conventionally. This fancy drawing, signed "Rowlandson," clearly shows the turreted tower of St. Mary the Virgin Church, founded in 1826 in Seymour-street, and in the Euston quarter, which was only first built about 1825–26, with the houses as they continue to exist to-day, but utterly different from the old conglomeration of ramshackle houses, as depicted in this view and meant to represent "Euston Square" in the foreground, although this square was not formed until 1826 out of a remaining portion of the extensive Bedford Nursery grounds, which had occupied sites both north and south of the New-road in 1808.

It is even questionable whether the "artist"—an obviously bad draughtsman—noted in his sketch book much more than this church of 1826, otherwise he would have shown, straight in front of him, the great blank of

vacant ground which in 1826 was still left unbuilt upon, and later on served for the London and Birmingham Railway line, its terminus and its clearing houses alongside Seymour-street extending right up to the point where the railway line passes under the Hampstead-road, near Mornington-crescent. Instead, this imaginative "artist" crowded the whole background to the north with quaint houses where only open fields and meadows existed in 1808. Not a road had yet been cut there in 1808.

As regards the Bedford Nursery, south of the New-road, and extending in 1808 down to the north side of Tavistock-square, this consisted of about 16 or 18 acres of park-like nursery grounds surrounded by trees and laid out with neat paths and shrubberies, an ornamental pond or lake, and greenhouses and a palm house. This was exploited as a horticultural establishment until about 1826, but with gradually diminishing areas.

Whence, then, arose the myth, never to my knowledge seriously contested by anyone until, about 1929 when I first published the corroborative London plans of 1808 in connection with the Trevithick Press announcements of 1808? The first mention of "Euston-square" seems to have occurred some twenty-eight years after that event, and, seemingly, inspired by the recent arrival of the London and Birmingham Railway near the northern half of the Bedford Nursery, then named "Euston-square." Where *The Times* of July 12th, 1808 (No. 7411) unmistakably indicated Trevithick's northern railway site of that month as being in "a field near Tottenham Court-road, and adjoining the Bedford Nursery," some writer in the *Civil Engineers' and Architects' Journal* of 1836 (Vol. II., page 94) managed by loose diction to side-slip eastwards from that "field" on to "Euston-square"—as that remnant of Bedford Nursery had, since 1826, been named. Then Hyde Clarke, staunch admirer of Trevithick, editor of the *Railway Herald and Railway Register*, simply quoted in No. 27, Vol. V., February, 1847, from the other paper named, but without assertion of its correctness.

From that time to this the overwhelming majority of writers has followed this lead about "Euston-square" and with such conviction as to its accuracy that they, and some technological historians, regard with coldness and suspicion any effort now made to draw their attention to the correct situations of the exhibition railways as were advertised by the promoters themselves in 1808, and for the purpose of guiding visitors to them. They prefer still the fiction—just as the majority of British folk prefer to be told that "Stephenson invented the locomotive," or that, if Trevithick really did so, that was simply because he applied Watt's engine to wheels (per H. G. Wells, in "Outlines of History").

Very singularly, only two persons with actual experience of the 1808 railways—Mrs. Guilmard and John Isaac Hawkins—left written records of them, and these confirmed, but without mentioning them, the Press announcements of 1808. But their evidence and that of the 1808 advertisements run counter to popular notions, and are therefore ignored.

In the *Mechanics' Magazine*, Hawkins wrote a letter dated March 27th, 1847, indicating the northern railway site (of July, 1808), as "a field near, or at, the spot now forming the southern half of Euston-square."

Had he meant that the site was the Bedford Nursery south, he would not have used the word "field." Thus he confirmed the situation described by the advertisements published by *The Times* and the other leading newspapers in July, 1808. With the great size of the Bedford Nursery the difference of position is a considerable one.

The southern site of September, 1808, referred to by the *Observer* as "the fields near Russell-square," thus indicated the eastern side of the "fields"; while Mrs. Guilmard indicated the western side of the same fields as "the waste piece, now Torrington-square." This same field, formerly the "Field of the Forty Footsteps," was circumscribed by the houses in Woburn-place (east) and Gower-street Mews (west), now Malet-street; and on the south by three houses in "Torrington street, East Side," as shown textually in 1808 by the Poor Rate-book of St. Giles (now Borough of Holborn). While Mrs. Guilmard's knowledge of such things has elsewhere been reflected upon adversely by opponents in this matter, it has to be remembered that from 1797, at Tredrea, St. Erth, she was interested in his high-pressure enterprises, and that women generally in Cornwall have been apt to know a good deal more about certain steam machinery than some London engineers.

CHARLES R. KING.

London, N.W.5, October 25th.

NATIONAL TRANSPORT.

SIR,—I think I may fairly claim to have opposed and criticised the post-war over-development of road transport and our road-making mania as strenuously and severely as anyone, but I hope that this National Government will pay no attention whatever to any recommendations of the Salter Committee which may amount to taxing any form of road transport out of existence.

I have no use whatever for long-distance road transport services for goods or passengers, an economic absurdity in all but few and special instances, and hope to see them speedily brought to an end; but the pontifical disobligingness of the railway managements, and gross blundering of the State, which brought them into being, should never be rectified by flagrant injustice.

Ever since the war all political parties have been involved in the squandering of hundreds of millions upon irresponsible road-making, mainly as an unemployment expedient, the public has been encouraged to believe that it all meant new roads to Utopia, and thousands of people under the influence of this State propaganda have invested in all kinds of road services.

To tax any of them into extinction under a hypocritical pretence of securing a fair contribution to road upkeep costs, or to end what is nauseously described as "unfair competition" in the same way, would be more than enough to write "Finis" to the Government. What could be more ridiculous than to pile taxation on the heavy vehicles of the travelling showmen, who are public benefactors, limited in number, obviously unable to employ other transport to a great extent, and who do negligible injury to the roads?

It seems to me that by far the better way of dealing with this matter would be to liberally reduce the taxation on all goods and passenger vehicles over a certain weight for the next five years, after which no such road vehicles should be allowed on the roads at all, except in the case of limited traffic of abnormal character.

On such lines, those affected would be enabled to create special sinking funds and write off their equipment over that period, and there would be a sufficient interval of time to create new employment for all who might be displaced, to protect the public by drastic overhaul of the railway services, and also to secure cheap transport for trade and agriculture by remodelling the inland waterways and improving our smaller coast ports.

It is lamentable that in this time of stress, with the outlook precarious in the extreme, that the Ministry of Transport, potentially as important as any we have, should remain a puppet department unwilling or unable to formulate a national policy and give the public cheap goods carriage and travel, with efficient services and fair play all round. Surely, if this National Government is in any way worthy of the name, no cause is more deserving of endeavour.

Yeovil, October 22nd. G. C. C. HENDERSON.

REINFORCED CONCRETE RAILWAY UNDERBRIDGES.

SIR,—Referring to the most interesting article that appears on page 400 of the current issue of your periodical, on the subject of the useful life of reinforced concrete railway underbridges, I would respectfully point out that there are a large number of such structures on the Northern Railway of France and also on the Belgian railway system. I think I am correct in stating also that the Eastern Railway of France has also a number of such bridges.

So far as the two former lines are concerned, I personally paid a visit to numerous underbridges, many of large span, during the reconstruction of the devastated areas in 1919 and early part of 1920, the vast majority of which were being built in reinforced concrete only. It would be extremely interesting and instructive to have published figures showing the cost of repairs to these bridges compared with similar spans of steel work. I have frequently wondered how they were standing up to the loads, but have thus far seen no reference to these particular bridges in any technical papers.

The examples of this class of work which your correspondent quotes, are doubtless of bridges built on South American railways under British administration (as are the majority of railways over there), and it is well known that we, as a race, are usually very reluctant to adopt reinforced concrete for underbridges that have to withstand the hammering of a heavy locomotive going at speed. Hence the examples quoted are those of small span only, although, paradoxially, the impact effect is greater on small spans than on large.

I suggest that the two systems I mention could supply most useful data as to the behaviour of this material under working conditions, and that you, Sir, would be doing a considerable service by asking them for this information and publishing it.

P. C. RUTHVEN, A.M. Inst. C.E.

Eastbourne, October 25th.

NEW PATENTS AND DESIGNS ACT.

SIR,—The Council of the Chartered Institute of Patent Agents has refrained from suggesting in the Press that those interested in or affected by the provisions of the above Act should consult their patent agents, because the Rules which so largely control details of procedure under the Act have not hitherto been published.

I am instructed by my Council to ask you to be good enough to publish this letter stating that the Rules, which were signed this week, were placed in the Patent Office Library this afternoon, where they can now be inspected by the public. Hence, definite advice and information can now be obtained from any patent agent by those whose patents or applications are in any way affected. H. THOMPSON, Secretary.

The Chartered Institute of Patent Agents,
London, W.C.1, October 26th.

SIXTY YEARS AGO.

IN an article, a column long, in our issue of November 1st, 1872, Macquorn Rankine gave his academic blessing to the "aero-steam" engine, a form of prime mover which at that time was attracting a certain amount of theoretical and experimental attention. It had been found by experience that the injection of a certain small quantity of air into the steam supply to an engine produced an improved degree of economy. The air might be heated in tubes additional to the normal heating surface of the boiler, or it might consist of part of the products of combustion freed from dust. In either case the improved economy was to be ascribed to the fact that the heat in the air was so much additional thermal energy extracted from the coal and passed into the working fluid. Professor Rankine's object was to show that the practice was also beneficial to the economy from the thermodynamic standpoint, and to suggest that it might be carried further than it had been. One of the chief factors which prevented the steam engine from realising its full theoretical efficiency was, he said, the fact that the feed water took in its heat not at the highest temperature, but at all temperatures from that at which it was received to that at which it was evaporated. Thermodynamically, it was desirable that changes in the temperature of the working substance ought to be produced mechanically, rises by compression and falls by expansion. The temperature of the feed water was, however, raised not mechanically, but by the direct expenditure of the heat in the fuel. In an air engine, such as Joule's, it was possible to approach the ideal conditions. If the air were heated at a pressure of five atmospheres and cooled at a pressure of one atmosphere, the theoretical efficiency of such an engine would be about 37 per cent. A steam engine working between the same pressure limits would have a theoretical efficiency of only 12·4 per cent. It was easy to see in a general way, said Professor Rankine, that an engine using as its fluid a mixture of air and steam would have an efficiency intermediate between these two figures. Dry air alone would theoretically give the greatest efficiency, but in practice great difficulty attended its employment, chiefly because it had been found to be almost impossible to prevent the heating vessel from becoming overheated and burned. There was, however, a certain proportion of air to steam which might be used, and which would enable all the heat required for raising the temperature of the working fluid to the upper limit to be produced by the compression of the air. Thereby the efficiency of the engine would be prevented from falling materially below the theoretical value. As a result of calculation he found that if at each stroke a mass of air were introduced equal to one and one-third times the mass of the feed water employed, the whole heat necessary for raising the temperature of the air-and-water working fluid could be obtained from the compression of the air alone from one atmosphere to five atmospheres. The example was applicable to a non-condensing engine, but the same argument, he contended, could be applied to the case of a condensing engine, provided an air pump of sufficient size were used. The aggregate volume of air and steam required in order to produce a given power would, he added, be nearly the same as the volume of steam alone required for the same power plus the volume of the air compressing pump.

INSTITUTION OF MECHANICAL ENGINEERS.

ON Friday evening of last week, October 21st, the annual dinner of the Institution of Mechanical Engineers was held at the Connaught Rooms, London. Mr. William Taylor, the President, occupied the chair, and was supported by about 420 members and guests. It had been announced that Mr. Rudyard Kipling was to have been present, but, unfortunately, illness prevented him from attending. The toast of "Bench and Bar" was proposed by Mr. Charles Day, and was responded to by Mr. Justice McCardie and Sir Maurice Gwyer, H.M. Treasury Solicitor. Colonel A. E. Davidson proposed "The Guests," the response to which was made by Dr. Foxley Norris, Dean of Westminster, and Air Vice-Marshall Dowding. "The Institution" was given by Mr. W. C. Noxon, Agent-General for Ontario, and was acknowledged by the President. There was an excellent muster of those members who took part in the Canadian visit during August and September. For the most part arrangements had been made to enable them to sit together or at adjoining tables, but, even so, the occasion did not provide a full opportunity for the renewal of friendships and the discussion of experiences. It was therefore suggested that at an early date the "Canadian" members and their ladies should meet together at an informal dinner. The proposal was warmly received.

BRITISH CHEMICAL STANDARD FOR CUPRO-NICKEL "A."

HEADQUARTERS of British Chemical Standards announce a new non-ferrous standard cupro-nickel having the following analysis:—

	Per cent.		Per cent.
Copper	68·85	Magnesium	0·027
Nickel	30·08	Carbon	0·02
Silicon	0·12	Sulphur	0·01
Manganese	0·89	Lead, not above	0·01
Iron	0·05	Cobalt, not above	0·01

This sample will serve as a standard for the analysis of cupro-nickel sheets and strip referred to in the British Standard Specification No. 374—1930. It may be used also for checking the analysis of the following cupro-nickel alloys:—Condenser tubes, bullet envelopes, coinage, electrical rheostats and resistances, base metal thermo-couples, domestic utensils.

It is believed that this is the only standard of its kind issued in either Great Britain, America, or the Continent, and it is therefore likely to be of international interest.

As usual, the standard turnings have been analysed by a number of chemists representing the different interests involved, viz., independent analysts, Government department, railway chemist, cupro-nickel manufacturers and users. The standard is issued in bottles containing 500 grammes, 100 grammes, and 50 grammes, and each bottle is provided with a certificate showing the detailed analysis of each chemist, together with an outline of the methods used. It is issued at a price which is estimated to cover eventually the cost and may be obtained from Ridsdale and Co., British Chemical Standards Headquarters, 3, Wilson-street, Middlesbrough, or from laboratory furnishers.

The Surbiton Waterworks.

No. I.

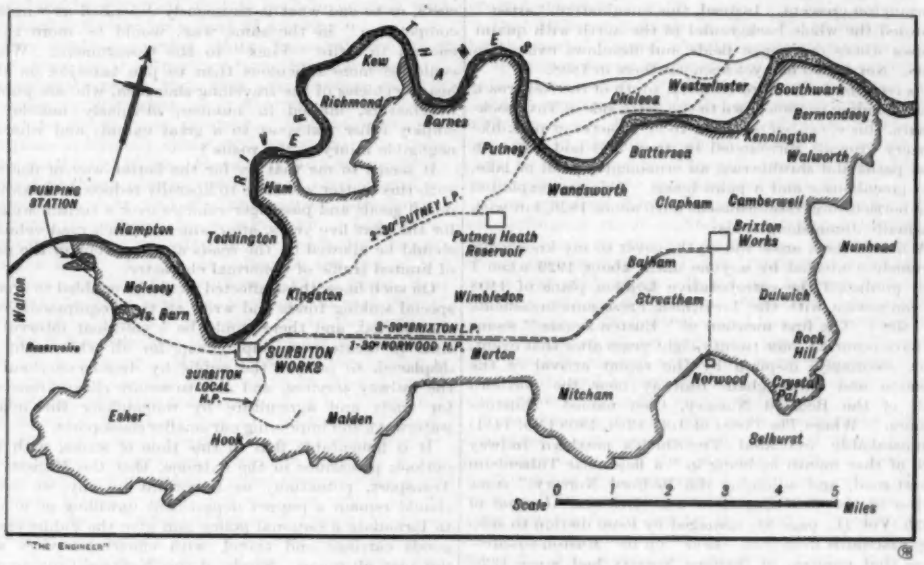
The mediæval tower-like smoke stacks of the Surbiton waterworks, just above Kingston Bridge across the Thames, must be familiar to many travellers along the Portsmouth road and those who frequent the river. They really seem to belong to the past, and it may surprise some of our readers to hear that those buildings now house some of the most modern pumping plant in existence, for the transformation has been effected without any interference with the service and very little visible outside disturbance. The old beam pumping engines have gone, although it is hoped that some one may be saved for museum purposes. The old Cornish boilers have gone; but the buildings remain. The old beam engines, whose top ends used to wink up and down through the windows of their high engine-house, have been replaced by turbine-driven sets, in which hardly a moving part can be seen, while the "tank" boilers have given place to the most modern of water-tube steam generators. And the irony of the change lies in the fact that the old engine-house has been found most appropriate to the accommodation of the modern boiler, while there was ample headroom in the old boiler-house for the turbine-driven pumping sets.

Although some of the old equipment was serving still with a fair thermal efficiency, the change was inevitable, as some of the boilers were as much as eighty years old, and most were over fifty. When it became imperative to replace them, the Chief Engineer of the Metropolitan Water Board, Mr. H. E. Stilgoe, C.B.E., M. Inst. C.E., decided on a complete rearrangement of the plant. This new plant, which is to be inaugurated officially on November 1st by the Minister of Health, is illustrated by the engravings on this page and on pages 429 and 432; but before going on to describe it, it may be of interest to give some historical notes concerning the old equipment.

The Surbiton station comprises the two works of the Lambeth Waterworks Company and of the Chelsea Waterworks Company, which were taken over on the organisation of the Metropolitan Water Board. They were built in 1850 and in 1854 respectively, and drew their water directly from the Thames at local intakes within 100 yards of each other.

The Lambeth company pumped the water, after filtration, to service reservoirs at Brixton, where a portion of it was re-pumped to six other service reservoirs at Norwood, Selhurst, Streatham Hill, Forest Hill, and Rock Hill, and to the Crystal Palace tank, while in the year 1882 water was supplied direct to the neighbouring district of Coombe. The Chelsea company pumped the water, after filtration, to service reservoirs on Putney Heath, whence it gravitated into the important districts of Fulham, Chelsea, and Westminster.

In the year 1874 the Lambeth company constructed an intake higher up the river at Molesey, and in 1877 the Chelsea company, also, made a new intake at Molesey, within a half-mile of the Lambeth intake. Both the companies built storage reservoirs and installed machinery to abstract the water from the river, but later on it was found to be more economical to pump unfiltered water from the Thames at Walton a little higher up the river and to deliver it into the Walton, Island Barn, and Molesey storage reservoirs, which are shown on our sketch map, with the new machinery installed at Walton.



SKETCH MAP OF THE AREA SUPPLIED WITH WATER FROM SURBITON

This water is conveyed to the Surbiton works from Island Barn and Molesey reservoirs by a brick culvert, 5ft. 9in. by 4ft. 6in., a 54in. diameter, and three 36in. diameter mains, all of cast iron. It is filtered through twenty-eight slow sand filter beds, having a total area of 30 acres. This system of abstraction and filtration is still in operation.

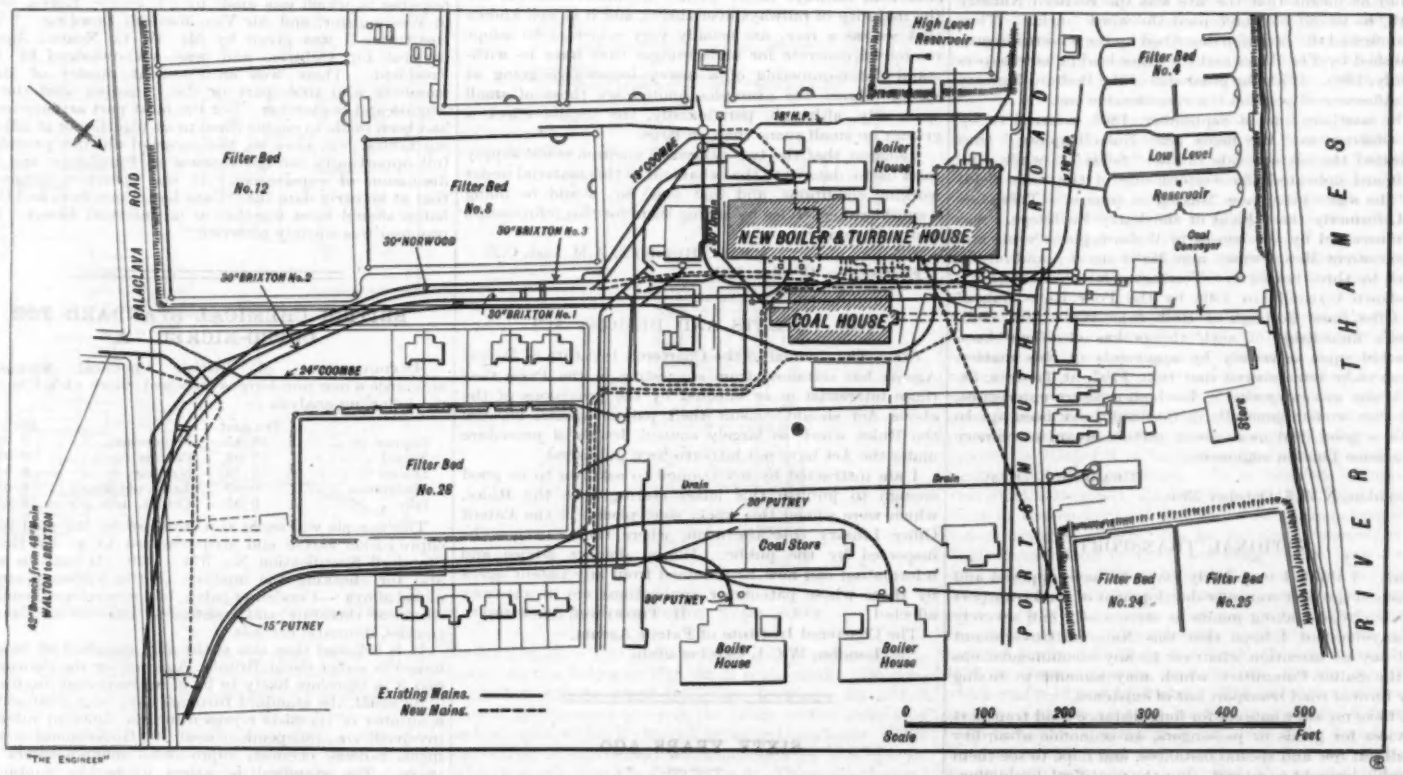
As is usual in the schemes adopted by the Metropolitan Water Board for the construction of new pumping stations or for the remodelling of existing stations, due regard has been paid to intercommunication of the water supplies to the zones served by the station under consideration and those supplied from other existing stations, the trunk mains from which pass near to the trunk mains from the new or remodelled station. The first aspect of this interchangeability has been dealt with in the design of the new pumps, and the arrangement of the mains. By these means any of the new high-lift units can pump to any two of the four zones supplied. By means of further connections made between mains in the confines of the works assistance may be rendered to the areas supplied from Surbiton by the high-lift pumps installed at Walton about six years ago.

The Hampton to Nunhead 42in. diameter pumping main is, for a considerable portion of its length, laid parallel with and contiguous to the 30in. pumping mains from Surbiton to Brixton, &c., although it has no concern with the supply of water to the area under consideration. It is proposed, however, to

Table I.

Unit No.	Capacity in million gallons per 24 hours. Main.	Booster.	Speeds.	Total heads in feet. Main.	Booster.	Water horse-power. Main.	Booster.	Total W.H.P.	Generator kW.	H.P., water and electrical.
1	22	7	Normal	215	175	994	258	1252	—	1252
	—	—	* Maximum	250	200					
2	22	6	Normal	215	165	994	208	1202	—	1202
	—	—	* Maximum	250	190					
3	24	6	Normal	155	155	781	196	977	200	1245
	—	—	* Maximum	180	185					
4	24	5	Normal	155	150	781	158	939	200	1207
	—	—	* Maximum	180	180					
Spare Impellers: Main pumps ..	22	—	Normal	180	—	832	—			
Booster pumps	—	6½	Normal	—	185	—	253			

* 10 per cent. in excess of normal.



PLAN OF THE SURBITON WATERWORKS, WITH THE NEW PLANT CROSS-HATCHED

THE SURBITON WATERWORKS

THE OLD BUILDINGS IN COURSE OF RE-EQUIPMENT

make connections between the 42in. and the 30in. diameter Surbiton to Norwood mains, so that in the event of an accident to the former, water may be transferred from the main carrying water from Surbiton to Norwood, and thus ensure a supply to certain districts which would otherwise suffer a shortage until the 42in. main could be restored.

We are not concerned immediately with the derivation of the water pumped at Surbiton, but a few notes on the plant at Walton may be of interest.

The unfiltered water plant at Walton includes four sets of Gwynne pumps, driven by high-speed triple-expansion engines. The pumps are interesting on account of the fact that they have been made two-stage by transferring the water from one side of a single impeller to the other side by outside pipes. Another interesting machine in this station comprises a pair of pumps driven by a Gilbert Gilkes water turbine. This machine is used, in the event of water being drawn off from the high-level reservoir for low-level supply, to utilise the energy of the fall in pumping water from the river.

In addition, a steam turbine-driven centrifugal pumping unit is being installed at Walton for extracting a further 20 million gallons per twenty-four hours from the river. The steam turbine is of Messrs. Richardsons, Westgarth's manufacture with Worthington-Simpson pumps. This unit will also drive a 150-kW electric generator for service in the works.

The quantity of filtered water to be pumped away from Surbiton amounts to 45 million gallons per twenty-four hours, and the continuous water and electrical horse-power when pumping this quantity day and night is 2333, but the plant will be capable if required of pumping continuously 60 million gallons per twenty-four hours (or sufficient to supply any town in the British Isles outside London), when the output in water horse-power would be 3100.

Provision has, therefore, been made for a normal continuous daily output of 15 million gallons to the Putney reservoirs, 19 million gallons to Brixton reservoir, 6 million gallons to Norwood reservoir, and 5 million gallons to the high-level districts of Coombe Hill, Esher and Claygate, or any combination of these quantities. Normally, about 5 million gallons per day of the water pumped to Brixton is re-pumped at Brixton into Norwood reservoir, but as it will be more economical to pump this water direct from Surbiton to Norwood with the new units, this quantity has been provided for in the design of the new pumps.

The New Plant.

The main portion of the new machinery consists of four steam turbines, taking steam at 250 lb. per square inch pressure and a total temperature of 600 deg. Fah., two of which can carry the normal station load, driving, through gearing, centrifugal main pumps and centrifugal booster pumps. Each of the booster pumps is driven through a coupling on the main shaft, and, in addition, two of the units each drive through a coupling operated by hand while running, an electric generator of 200 kW capacity made by the General Electric Company, Limited.

The conditions under which the pumps are required to work are shown in Table I.

Each of the units is capable of pumping to any district, but the design of the pumps differs slightly in each case, in order to secure the maximum efficiency at the expected normal conditions.

In addition to these main pumping units, electrically driven and water-turbine-driven centrifugal pumps are to be provided for raising filtered water from the low-level filter beds at Surbiton into the suction tank of the main units and also for raising raw unfiltered water from the low-level to the high-level reservoirs in the event of a breakdown of the main from Island Barn reservoir, but this portion of the work cannot be completed until the first new section is in regular operation, the buildings at the end of the new turbine-house not being available until the existing beam engines can be dispensed with. When these engines are finally supplanted by the new turbine sets, their place will be taken by the electrical and water-driven low-lift pumps. We hope to revert to these rather interesting machines in a future issue. The tail-race water from these water turbines will return to the main filtered water culvert. The estimated cost of these pumps is £16,000.

The variation in the relative quantities required in the two districts served by the same pumping unit is balanced by using either surplus low or high-pressure water for operating the water-turbine-driven low-lift pumps and the auxiliaries, or by driving them electrically if the whole of the water is required in the districts.

The whole of the auxiliary plant and certain of the low-lift pumps can be run, and the supply from this station carried on even if there should be a complete failure of the electrical power, all auxiliaries being water-turbine operated as well as electrically driven.

Tables II., III., and IV. give the conditions under which the low-lift pumps will work.

(To be continued.)

TABLE II.—*Filtered Water Low-lift Pumps.*

Unit.	Capacity, mill. gallons per 24 hrs.	Total static head.	
No. 5 electric	11 m.g. 10 ,, 8 ,,	20 to 25 20 to 28 20 to 25	Normal
No. 6 electric	8 m.g. 7 ,, 5 ,,	20 to 25 20 to 28 20 to 25	Normal
No. 7 water driven	11 m.g. 10 ,, 8 ,,	20 to 25 20 to 28 20 to 25	Normal
No. 9 water driven	5 m.g. 4 ,, 3 ,,	12 to 20 12 to 24 12 to 20	Normal
No. 10 electric	5 m.g. 4 ,, 3 ,,	12 to 20 12 to 24 12 to 20	Normal
No. 8 water-driven electric generator	50 kW	210 volts	

TABLE III.—*Unfiltered Water Low-lift Pumps.*

Unit.	Capacity, mill. gallons per 24 hrs.	Total head, in feet.	
No. 11 water driven	11 m.g. 10 ,, 8 ,,	36 to 46 35 to 45 33 to 42	Normal
No. 12 water driven	11 m.g. 10 ,, 8 ,,	36 to 46 35 to 45 33 to 42	Normal
No. 13 electric	11 m.g. 10 ,, 8 ,,	36 to 46 35 to 45 33 to 42	Normal
No. 14 electric	11 m.g. 10 ,, 8 ,,	36 to 46 35 to 45 33 to 42	Normal

TABLE IV.—*Drainage Water Pumps.*

Unit.	Capacity, mill. gallons per 24 hrs.	Total static head.	
No. 15 electric	0·40 m.g. 0·35 ,, 0·20 ,,	15 to 25 15 to 25 10 to 22	Normal
No. 16 electric	2·00 m.g. 1·75 ,, 1·00 ,,	10 to 24 10 to 24 8 to 16	Normal

Colloidal or Coal-Oil Fuel.

The problem of utilising suspensions of very fine particles of coal in fuel oil, which has received very wide publicity since the successful trials carried out on the Cunard liner "Scythia," was discussed technically by Professor J. S. S. Brame, C.B.E., F.I.C., in a paper which he presented on Friday, October 14th, at a meeting of the Chemical Engineering Group of the Society of Chemical Industry, in London. Mr. J. Arthur Reavell, chairman of the Group, presided.

There is not a great deal of information yet available on the subject, and in reply to a request for some details from the Cunard Company, Professor Brame was informed by the assistant superintendent engineer that publication of such details as he desired would be premature at this juncture.

The idea of using such fuel, Professor Brame pointed out, is by no means new, for extensive experiments were carried out in the United States during the later years of the war. Dr. R. Lessing also disclosed, in the course of the discussion, that he had carried out some work in this connection for the British Admiralty even earlier than the American experiments. The results, he added, had not been published in the technical papers, or even in company prospectuses.

Among the advantages claimed for the use of coal suspensions in oil by Lindon Bates and H. O'Neill (who carried out the American experiments) were that such fuels possessed higher calorific value per unit volume and greater combustible efficiency, that no modification of the usual oil-burning plant, and no new type of plant for preparation of the fuel, was necessary, and easy transport in tank cars and through pipe lines was secured. Professor Brame pointed out, however, that on average values the calorific value per cubic foot of fuel oil and of coal, assuming no interspacing, was practically the same, so that it was impossible to concede that the mixture could have a higher calorific value on a volume basis than the separate components.

Such a fuel, to be of value, must possess a reasonable degree of stability for a fair length of time. Prolonged stability might not necessarily be required, but Bates considered that it would be satisfactory for most purposes if ensured for a month or two. The methods of obtaining stability were to use certain protective substances, such as soap solutions, a typical substance mentioned being a variety of lime rosin grease; to peptize bituminous coals to a limited, but sufficient, extent by the addition of suitable quantities of coal distillates, such as tars and middle fractions, and by intensive grinding to reduce the coal to particles of colloidal or practically colloidal size. Contact with salts in solution would generally cause coagulation in colloidal suspensions, with their rapid precipitation, but it was claimed by Bates that contact with salt water, even with vigorous agitation, did not cause separation of the coal. Professor Brame stated, however, that the only sample of colloidal fuel prepared by Bates which he had had an opportunity of examining had deposited nearly the whole of the coal in the form of a soft, black mud.

It did not appear probable, he said, that with the grinding which was practicable for coal for admixture with oil, many particles of ultra-microscopic dimensions were produced; the stability claimed for the colloidal fuel, therefore, was probably due to the emulsoid character of the oil in which particles were suspended.

Coming to the economic aspects, Professor Brame said that for use on shore it seemed unlikely that oil-coal mixtures would be successful in competition with mechanical stoking, and particularly with the use of powdered coal. For marine purposes the competition was not only with oil fuel, but also with coal. The fact that the coal-oil mixture could be stored in the oil bunkers or double bottoms of a ship and handled with the usual pumping plant, if such were provided for oil fuel, gave it a distinct advantage over solid coal in any form.

Whilst no opportunity could be overlooked to increase the use of our home-produced fuel, it seemed that very exaggerated ideas of what the introduction of coal-oil fuel might mean to the coal trade were current. Professor Brame pointed out that, taking the mercantile marine and the Navy together and assuming that nothing but coal-oil fuel was used, the resulting increased demand for coal would amount to approximately 1 million tons—a very small increment in our total coal output of about 240,000,000 tons. As Professor Louis had pointed out, the type of coal used for bunkers was a hard coal, such as was obtained largely in South Wales (see THE ENGINEER, July 15th, 1932, "Oil-coal Fuel for Steamships," by Henry Louis). For mixture with oil, softer types of coal, which were more easily ground, and procurable over a wider area, would have obvious advantages. Another possible source of suitable material would result from the extension of the dry-cleaning process for coal.

As to the disadvantages, he pointed out that unless the mixture had a guaranteed stability there was obviously a big risk of deposit in the tanks and pipe systems, with the possibility of the blocking of suctions. Extra wear and tear of pumps and burners must be expected. Combustion in the immediate vicinity of the burner tube did not appear to be as good as with oil alone, for it was reported in the case of the "Scythia" that the burners required clearing about twice as often as with oil fuel.

In the discussion which followed the reading of the paper, Dr. W. R. Ormandy said that if coal were ground in the same way as for coal-dust firing, then the particles could not be called "colloidal," and they would have a gravity practically twice that of the oil in which they were suspended. A very large number of crude oils were

full of colloids, however, in the chemical sense, which might play a very big *rôle* in holding up the coal particles. Two oils of very similar viscosity might have quite different internal properties, and coal which was stable in one for a sufficient time for the practical purposes required might be absolutely unstable in the other.

A point made by Dr. R. Lessing was that coal is a colloidal substance, and that therefore, the problem was not merely one of reducing the coal mass to what was usually considered to be colloidal size, but was rather a question of the colloidal surfaces that the coal offered to the surrounding oil in which they were immersed. It must not be imagined that the desired effect could be produced by simply applying a standard process to any coal and any oil. Coals of different kinds would behave very differently indeed. Further, some oils attacked the coal in such a way that the surface became predisposed to form either an emulsion or something approaching a colloidal solution. He would not be surprised if it were possible to find the right combination so that even stabilisers would not be necessary. A prime condition for the success of the proposition was that the coal must be as free from ash as it was possible to make it. The settling down or destabilising of the coal in the mixture, and other factors, were largely conditioned by the ash content.

A suggestion made by Mr. P. C. Pope (Secretary of the Institute of Fuel) was that the use of oil-coal mixtures had more chance of commercial success inland than at sea, in cases where oil was being used for industrial furnaces, &c., for oil was more costly inland than at the coast. He agreed with Professor Brame, however, that it seemed unlikely that such mixtures would be successful on land in competition with mechanical stokers, and particularly with the use of powdered coal.

A speculation made by Dr. A. J. V. Underwood was that there might be a future for a combination of powdered coal and oil with a subsequent carbonisation or cracking process. Conceivably, if a suspension of coarse particles of coal in oil were heated under pressure, as in a carbonisation process, and the pressure were suddenly released, the larger particles would be subdivided to a fineness which would give a stable suspension. The products of the carbonisation or cracking process might pay partly for the cost of pulverisation.

The point of view of the naval architect was put by Mr. E. F. Spanner, who pointed out that fuel stored in the double bottoms of ships had to be heated in order that it could be pumped to the engine-room. The fuel in the vicinity of the steam pipes used to heat it would be at a higher temperature than the general body of the fuel, and if, as the result of that heat, coal particles were deposited on the pipes, they would have an insulating effect, and the general character of the oil would be altered. That problem was fundamental, because, if it were not possible to use a mixture which did not deposit the particles on the pipes, it would be impracticable to store oil-coal mixtures in double bottoms, which was essential in large vessels. The question was answered by Mr. Pope, who pointed out that in the Todd Company's experiments, which had extended over several months, no trouble was experienced through the deposit of coal on the heating pipes.

Mr. L. H. Sensicle, who commented upon the compactness of oil-coal mixtures, said it was conceivable that the collieries might pulverise coal and sell it mixed with oil, and that the oil used might itself be a product of coal—a coal-oil from low-temperature carbonisation processes, or an oil produced by hydrogenation.

Lloyd's Register of Shipping.

ANNUAL REPORT.

The annual report of Lloyd's Register of Shipping for the year 1931–1932 has just been issued, and in what follows a summary of its principal contents is given.

In reviewing the operations of Lloyd's Register of Shipping for the year ended June 30th, 1932, certain points may be specially noted, namely:—(*a*) The continuance of the deep depression in shipping; (*b*) the consequent increase in the tonnage laid up and decrease in the orders for new ships; (*c*) the large volume of work undertaken by the Society following upon the adoption by most of the maritime countries of the International Convention respecting load line; (*d*) a marked extension in the scope and variety of the Society's activities due to a growing demand for the inspection and testing by Lloyd's Register of materials and machinery not intended for marine purposes; and (*e*) the amalgamation of the civil aviation interests of Lloyd's Register and the British Corporation Register. These several points are dealt with in some detail in the following report.

The Shipping Outlook.

The depressed condition of shipping, which has continued during the past year, shows no indication of immediate improvement. The freight market, on which the prosperity of shipping mainly depends, has continued on a very low level throughout the year under review, with the result that large numbers of ships have been unemployed and many vessels kept running have been operated at a loss.

Two years ago the gross tonnage of vessels laid up throughout the world owing to lack of employment was estimated at 5,000,000 tons. Last year the laid up figures had reached 10,500,000 tons. This year they have grown to the enormous total of 15,000,000 tons, or more than 20 per cent. of the world's available tonnage. On the other hand, however, the Society's statistics show that for the first time for some years there was a decrease of 400,000 tons this year in the world's merchant shipping tonnage, which is now slightly less than 70,000,000 gross tons. Different proposals for concerted action to deal with the problem of surplus and obsolete tonnage have been made from time to time, but nothing of a concrete nature has resulted until recently, when special steps were taken in certain countries to accelerate the breaking up of the older ships. The operations of Lloyd's Register have necessarily been affected by the world-wide shrinkage, but the Society has maintained its position.

New Vessels Classed During 1931–32.

During the twelve months ended June 30th last 263 vessels, of 920,902 tons gross, were completed and assigned the Society's classification. As was to be expected, these figures show a considerable falling off as compared with those of the previous year, when 557 vessels, of 1,758,610 tons gross, were similarly classed. Practically one-half of the new tonnage classed by the Committee this year was intended for the carriage of oil in bulk.

A similar decrease occurred in the number of plans submitted of new vessels to be classed by the Committee of Lloyd's Register. In the year ended June 30th, 1932, plans for 139 vessels, of 258,110 tons gross, were approved for classification with this Society, as compared with plans for 240 vessels, of 564,280 tons, similarly passed last year. The major portion of this decrease is accounted for by the drop of 225,000 tons in projected tanker tonnage, this year's figure reaching only 22,960 tons, as compared with nearly 250,000 tons last year. Approximately 60 per cent. of this year's contemplated tonnage (*i.e.*, 92 vessels, of 153,890 tons) was intended for construction in Great Britain and Ireland, the remaining 40 per cent. (47 vessels, of 104,220 tons) being for construction abroad. At the end of the period under review there were 108 vessels, of 640,798 tons gross, under construction throughout the world with a view to classification in Lloyd's Register. Of this total, 261,529 tons were being built in Great Britain and Ireland and 379,269 tons abroad, representing 93 per cent. of the home tonnage and nearly 60 per cent. of the total world tonnage. The total tonnage of merchant vessels afloat at the end of June, 1932, actually holding the classification of Lloyd's Register, was 33,521,488 tons gross. Including vessels under construction, the total number classed and intended to be classed in Lloyd's Register amounts to 10,099 vessels, of over 34,000,000 tons, which is practically half of the world's shipping.

Shipbuilding and Marine Engineering.

The principal large ships built during the year and classed with Lloyd's Register are enumerated both for Great Britain and abroad, and further reference is made to the high proportion of tanker tonnage and the continued increase in the number of motor ships. During the period under review 170 vessels, of 598,247 gross tons, were equipped with internal combustion engines, practically all for the use of heavy fuel oil. Eighty-two per cent. of the steamer tonnage built to class with Lloyd's Register this year was fitted for burning oil fuel.

Geared turbines were fitted this year in 10 new vessels, of 84,640 tons, built to the Society's classification. In four other vessels, of 73,667 tons, built to the Society's class, turbines were fitted in conjunction with electric drive, and particulars of these ships are given in the report.

During the year considerable attention was devoted to devices for increasing the efficiency of steam reciprocating engines, both in new and existing machinery, and a number of vessels have been fitted with valve gears of special design, with the object of taking full advantage of the economy resulting from the use of superheated steam. The existing practice of connecting an exhaust steam turbine to the main engine shafting was employed in three vessels built to the Society's class during the period. In two of them, the s.s. "Pan Bolivar" and s.s. "Hilary," the exhaust turbine is connected to the main shafting by reduction gearing and hydraulic clutch, whilst in the s.s. "Erin" the turbine drives a directly coupled electric generator, which supplies power to a motor mounted on the main shafting. Proposals have also been submitted for the consideration of the Committee, in which exhaust steam turbines are to be used: (*a*) for compressing the steam as it leaves the H.P. cylinder and before it enters the I.P. cylinder; and (*b*) for driving an electric generator supplying current to a reheating device, through which the steam from the H.P. cylinder passes on its way to the I.P. cylinder.

Tables compiled from the Society's records illustrate the relative proportions of (1) reciprocating steam engines, (2) steam turbines, (3) internal combustion engines, fitted in vessels built to class during recent years, and the proportion of tonnage propelled (*a*) by use of coal, and (*b*) by use of oil, either as fuel for boilers or motors.

Fifteen vessels were fitted with new refrigerating installations under special survey, a total of 1,555,590 cubic feet insulated capacity being dealt with, while surveys of frozen meat depôts at home and abroad were made and ten refrigerated railway cars were built under Lloyd's Survey. There was a decline in the amount of ship and boiler steel tested, but there was an increase in the services of the Surveyor required for land boilers in Great Britain and abroad.

During the year ten refrigerated railway cars have been constructed under the survey of the Society's Surveyors, in accordance with the Society's rules.

There was an increasing demand for the Society's Surveyors to undertake inspection and testing duties, apart from those directly connected with ships and their machinery, especially in cases of material or machinery intended for export, when both purchaser and manufacturer wish to avail themselves of the resident inspection service of an internationally recognised and impartial authority such as Lloyd's Register. The Society's practice in authorising its Surveyors to inspect, test, and certify to such material in accordance with any approved specification has proved of economic benefit to many Governments, public institutions and private firms, and during the year certificates have been issued by the Surveyors in respect of such varied material as structural steel for buildings, steel rails, canvas hose, steam and air receivers, pipe work, diving apparatus, and all kinds of electrical gear, forgings and castings. The Society's certificates of inspection during construction have been issued for a number of oil engines, not necessarily intended for marine purposes, including a batch of 92 oil engines, of similar type, built for the Soviet authorities, all of which have been constructed under the supervision of the Society's Surveyors and in accordance with the rules.

Other sections of the report deal with freeboard surveys under the new International Load Line Convention, fires aboard ships, the survey of press boilers on whalers, and the continuous survey of machinery on motor ships. The revised rules for special surveys of tankers and the application of arc welding to ship construction are also dealt with, while mention is made of the work being carried out on corrosion and research on the effect of superstructures.

The Committee refers with regret to the death, on October 14th, 1932, of Mr. H. A. Ruck-Keene, M. Inst. C.E., who had held the important position of the Society's Chief Engineer Surveyor since 1921. Mr. Ruck-Keene was appointed to the staff as an Engineer-Surveyor in 1890, was made a Principal Surveyor in 1907 and Assistant to the Chief Engineer Surveyor in the following year. Throughout his long term of high office with the Society he was prominently associated with the many alterations and additions to the rules consequent upon the adoption of Diesel engines and other important developments in marine propulsion, and the Committee desire to pay high tribute to the outstanding services which he so loyally rendered during his forty-two years on the staff, and which have been of the greatest value to the shipping community of the world.

Aircraft Inspection.

In the period under review, which concludes the third year of the Society's participation in the inspection of civil aircraft, the number of machines placed on the Society's list for the purpose of periodical survey, under the authority of the Air Ministry, has materially increased. At the end of June last approximately 300 aircraft were registered with the Society for this purpose, and in the course of the year 170 surveys for renewal of certificates of airworthiness, 60 surveys for damage or condition, and 100 interim surveys were carried out by the Society's Aircraft Surveyors in the United Kingdom on various types of machines. In addition to the above, damage surveys, on behalf of underwriters, were held in various parts of the world, including France, Norway, Greece, United States of America, British Columbia, South Africa, Japan, and Siam, those in the first three named countries being carried out by the Society's own Aircraft Surveyors, and the remainder either by the Society's resident Engineer Surveyors or by local aircraft experts appointed by the Committee on behalf of Lloyd's Register. In pursuance of the policy outlined in last year's report and with the co-operation of the Air Ministry, eight of the Society's Engineer Surveyors have completed a six months' course at various centres and works in this country, in order to afford them the opportunity of acquiring aeronautical knowledge before taking up duty at ports abroad.

Joint Aviation Advisory Committee.

As the result of representations from the several interests concerned in civil aviation, the Aircraft Branches of Lloyd's Register and the British Corporation have been amalgamated. A Committee, comprising all members of the Aviation Committees of both Societies, together with the Chairmen of the Registers, has been formed and has, by mutual agreement, adopted the title of "The Joint Aviation Advisory Committee of Lloyd's Register and the British Corporation Register." The Aircraft Surveying Staffs of the two Registers have been amalgamated, with Mr. L. J. Hill as Principal Surveyor, and the Aircraft Register, previously published by the British Corporation, will now be issued in the name of the united body. It is confidently anticipated that this fusion of interests will place at the disposal of civil aviation a strong, independent inspection body, organised to deal expeditiously with any aircraft surveying duties required to be carried out in any part of the world.

A CAMP FOR FRENCH APPRENTICES.

(*By a Correspondent.*)

An interesting effort on the part of the French Federation of Industries to promote a better understanding between masters and men is taking place in the South of France.

The writer was privileged, a few months ago, to be the guest—with four other English apprentices—of the director of an enormous open-air camp run by the Parisian section of the Federation. In this camp, which is near Die, in the valley of the Drome, and about 45 miles from Grenoble, there were at the time about 500 French apprentices, mostly drawn from the works of Renault and other motor car manufacturers around Paris, all living under canvas. They were presided over by a permanent staff of about twenty and by a number of engineering students, whose duties were to organise excursions into the neighbouring countryside and generally to see that the apprentices were deriving the full benefit of their stay in camp.

The camp itself is extremely well equipped with permanent buildings, the most important being the dining hall and the assembly hall, where various entertainments are given every week. In addition, there are sports grounds, a large open-air swimming bath, a canteen and shop, hospital, and even a photographic dark room. The place is completely self-contained.

The lavish way in which the apprentices are entertained is most remarkable. A special train conveys them to and from Paris, and on arrival at Die they are presented with 200*f.*, so that they may make full use of the canteen and shop. They thus have no expenses from the time they leave Paris to the time they get back.

When at Die they do little more than make the camp their centre. The surrounding country is magnificent, right in the heart of the lower French Alps and quite unspoilt. It is an absolutely new experience to most of the visitors, and they make full use of their opportunities. Climbing and walking excursions are made up daily under the charge of the engineering students, who are entirely responsible for the work, and organisation entailed. In addition, tours by car are made to the Swiss border, to the Riviera, and to many other places. What makes the holiday so attractive is the perfect summer weather which can be guaranteed and the complete freedom in which one moves.

The apprentices arrive in batches of about 500 and stay for a fortnight, and as the camp is open for about two and a-half months in the year a considerable number get the benefit of an amazingly good holiday. The change in the boy after only a fortnight's stay is almost incredible. Thin and pasty faced, he arrives a typical product of an industrialised town. At the end of his trip he returns a picture of health.

Railway and Road Matters.

Three coaches of an L. and N.E.R. express from Hull to Sheffield, when travelling at 60 m.p.h., left the rails near Rotherham on Oct. 21st. There were no personal injuries.

Passenger traffic by road in New Zealand has been controlled under a system of licences since March, and draft proposals have now been issued under which it is proposed to control goods traffic, to be started in December.

The Great Western Railway is constructing 125 containers for the conveyance of meat. They are of timber, the sides, ends, roof, and floor being double cased, with 1½in. of insulating material between, except for the floor, which will have 1in. For hanging the meat there are eight iron bars across the container, with six swivel hooks per bar.

The issue by the Southern Railway Company of £4,750,000 4 per cent. debenture stock was so successful that the lists were closed twenty-four hours earlier than was intended. The money is mainly intended to provide funds for meeting expenditure on the extensions at Southampton Docks and on the electrification to Brighton and Worthing.

The Committee appointed by the Minister of Transport to inquire into the two further pooling schemes will open the inquiry on Monday next, October 31st. The new proposals are those of the London, Midland and Scottish and the Great Western jointly and the London, Midland and Scottish, the London and North-Eastern, and the Great Western jointly.

After having completed the electrification of the Stockholm–Malmoe section, the Swedish State Railways are now planning to start electrifying the northern stretch of the main line between Stockholm and Aange, and are placing orders with Swedish firms for the material and equipment needed for the work. The total contracts to be placed are reported to amount to approximately 50 million kroner (£2,564,100), of which Swedish metal works are expected to receive about 3·5 millions and the cable works about 3 millions.

After a connection of forty-two years with the various railways which went to make, in 1893, the Midland and Great Northern Joint Line, Mr. W. E. Newman, the resident mechanical engineer, has retired, and has been succeeded by Mr. A. H. Nash, who started his railway career on the Great Western and, after being deputy locomotive superintendent on the Federated Malay States Railways, went to the Lancashire and Yorkshire, and now goes to his last appointment from the L.M.S. carriage and wagon department at Derby.

The Railway Rates Tribunal has sanctioned an experiment by the L.N.E.R. and L.M.S. companies in the charging of goods traffic between their London City stations and depôts (including the docks) and Southend. The experimental rates are based on a classification of weight per wagon and will be in three series, namely, 2 tons, 4 tons, and 6 tons per truck, and they will be charged irrespective of the nature of the traffic. Each series of rates is to be applied in two sets, one covering transit from station to station and the other covering transit from door to door.

In the *Railway Newsletter* for October mention is made of the fact that it is sixty years ago since the Midland Railway provided accommodation for third-class passengers on all trains. As the notice proceeded to say that it enabled the railway company to effect a saving of 500,000 train miles per annum, representing an economy of £37,000 a year, we were curious as to the authority for that statement. It was, we now find, made by Stretton in his "History of the Midland Railway," a source that we have on three or four occasions found to be in error. According to the Railway Returns for that period, railway business greatly increased after the Franco-Prussian War, and we find that the 190 million train miles of 1872 rose to 197 million in 1873 and to 200 millions in 1874. In fact, herein on April 1st last, when we mentioned this sixtieth anniversary, we quoted Captain Tyler as having said that the experiment of third-class passengers by all trains had led, where duplicate trains had not been provided, to overcrowding, and unpunctuality.

The paragraph as to automatic couplings in the "French Engineering Notes" of our issue of October 21st prompts the remark that although the agitation for that equipment on British railway wagons was begun sixty years ago, it may be said that in this country the subject is not only nearly dead, but almost forgotten. In his annual report on the railway accidents of 1875, Captain Tyler remarked that automatic couplings would materially contribute to the safety of men engaged in shunting. In 1886 and again in 1889 legislation was introduced, but later abandoned. Another attempt was made in 1899—on that occasion by a Government Bill—but it also failed, and the Royal Commission of that year on accidents to railway servants was set up instead. That body confessed that because automatic couplings were a success in the United States, it did not follow that that would be the case here, and that practical trials should be made. It was not until April, 1906, that the Railway Employment Safety Appliances Committee was appointed. Practical trials followed, but these almost ceased after Sir Arthur Yorke presented a memorandum which asked the following four questions: —(1) Whether, having regard to the small number of accidents in this country, due to the present method of coupling and uncoupling goods wagons, there is any such necessity for a change from the existing type of coupler to justify the large capital outlay and the dislocation of traffic which would be inevitable? (2) How, if the change is decided upon, the enormous expenditure connected therewith is to be met? (3) How the owners of private wagons are to be dealt with? (4) How the dislocation of traffic and risk of accident to men and trains during the experimental and transitional stages are to be faced? That practically settled the matter as far as this country was concerned. Moreover, the annual accident returns show the little need there is for automatic couplings. During 1931 out of 146 servants killed and 2633 injured in various ways, those killed in coupling and uncoupling numbered only three, with 340 injured. In 1930 there were six killed and the yearly average for 1925–29 was five, and for 1920–24 it was six.

Notes and Memoranda.

For constructional purposes at the Hoover Dam site a cableway is being stretched across the Colorado River, which will be capable of handling 150 ton loads. It will have a span of 1200ft. and be 605ft. above the landing stage. The hoisting speed will be 30ft. per minute.

The total length of the bridge connection across San Francisco Bay, between San Francisco and Oakland, will be 7½ miles. It will include a suspension span of 2310ft. over the West channel, a tunnel through the hills on Goat Island, and a cantilever span of 1400ft. over the East channel. The cost is estimated at 70,000,000 dollars.

Considerable progress has been made in the development of the 100,000 kW Galloway power scheme, which, when completed, will be one of the largest hydro-electric installations in this country. The scheme is being tackled in two stages. The first, now under construction, comprises two power stations, Tongland (ultimately 33,000 kW) and Glenlee (ultimately 24,000 kW), with three reservoirs along the valley of the rivers Ken and Dee. The second portion of the scheme will involve the construction of three power stations in series higher up on the Water of Ken above Dalry.

The American Smelting and Refining Company has, says the *Iron Age*, developed an iron and selenium alloy, a typical analysis of which is: Selenium, 52·11; iron, 41·42; carbon, 0·90; silicon, 0·72; phosphorus, 0·20; sulphur, 0·22 per cent. The ferro-alloy is heavier than pure selenium and is more readily assimilated by the steel bath. Early experiments by the Carpenter Steel Company of Reading in Pennsylvania were made with elemental selenium, but the losses in adding to the molten steel bath led to the adoption of the ferro-alloy. The outstanding effect of adding selenium to the bath is to make the steel free-machining.

X-rays promise to be of considerable value as a non-destructive means of examining welded metal. The methods employed were discussed in some detail in a paper which Mr. R. A. Stephen read recently before the Institution of Welding Engineers. X-ray equipment for this purpose is now obtainable in a compact mobile form which is shockproof and easy and safe to handle in a factory. Allied to the research work carried out by the present means of metallurgical attack, X-rays can also be used to regulate the best operating conditions of the welding current, to investigate the action of slag coatings, and to determine the correct rate of feed.

During the last twenty years, says *Steel*, the Carnegie Steel Company, of Pittsburg, has made numerous metallurgical investigations, supplemented by service tests, on carbon and alloy steel wheels, which had been treated in various ways. As a result of these investigations and tests, the Carnegie "rim-toughened" wheel was developed. The treatment consists of heating the wheels to the proper temperature to refine the grain structure of the steel, and then rotating the rim of the wheel in water. The wheels are removed from the rotating machine, and immediately returned to the furnace for drawing or tempering, as an added assurance that no injurious stresses are present. The life of the wheels is said to be doubled.

A series of British standardised steel samples has been issued jointly by the Iron and Steel Institute and the National Physical Laboratory. The standards at present available are: No. 1, sulphur (S=0·027 per cent.); No. 2, sulphur (S=0·071 per cent.); No. 3, phosphorus (P=0·029 per cent.); No. 5, carbon (C=0·65 per cent.) acid O—H steel; No. 6, carbon (C=0·10 per cent.) basic O—H steel; No. 8, carbon (C=0·27 per cent.) acid O—H steel; No. 9, carbon (C=1·09 per cent.) acid O—H steel; No. 11, manganese (Mn=0·69 per cent.) acid O—H steel; No. 12, cast iron standard sample (Si=2·22 per cent., P=1·14 per cent., Mn=0·50 per cent., S=0·075 per cent.). These samples are supplied, post free, at 21s. per bottle, containing 50 grammes, together with certificates of standardisation.

In the course of a paper read before the Birmingham branch of the Institution of Production Engineers, Messrs. E. W. Field and J. H. Garnett said that the cutting angles and clearances of tools should vary in accordance with the material to be cut. With Stellite a front clearance of not more than 6 deg. is advised, and the top of the tool should be ground with a side rake of 6 deg. for cast iron and 10 deg. for steel. With tungsten carbide, cast iron is best machined with a front clearance of from 4 deg. to 6 deg. and a top side rake of 10 deg. to 15 deg. This is increased up to 24 deg. for metals such as copper and aluminium, and reduced to as low as 3 deg. for hard metals such as manganese steel and chilled iron. For materials such as porcelain, marble, or Bakelite, the tools should have no top rake, and in some cases a slight negative rake is desirable. This applies particularly to form tools with sharp corners and unsupported points.

The manufacture of a good quality pencil requires a wood with uniform colour, good whittling qualities, ability to take lacquers, and sufficient strength to withstand splitting at the tapered end when sharpened. Southern red cedar or juniper wood possesses these characteristics to such an extent that it has been used universally for pencils for years, and has become known in many parts as "pencil cedar." The increased cost of Southern red cedar, as the wood became scarce, has resulted in the use of woods treated chemically under pressure to obtain the proper dark uniform colour and to improve whittling qualities. Chief among these woods was incense cedar from California, which, when treated, offered a satisfactory substitute for southern cedar, and at present holds an important place in pencil manufacture. The Forest Products Laboratories, Forest Service, Department of the Interior, Canada, following the receipt of many inquiries regarding the use of a Canadian wood for pencils, developed a treatment of Western red and Eastern white cedar to improve their colour and whittling qualities. Sample shipments sent to manufacturers of pencils for test in commercial pencil machines have resulted in some very favourable reports, which have engaged the interest of several Canadian firms in a position to supply cedar for such a purpose.

Miscellanea.

A new alluvial gold field is being opened up in the Tatshenshini River district of northern British Columbia.

The United States intends, it is announced, to begin next year the construction of another 10,000-ton cruiser to carry 8in. guns.

Another well has been drilled and "brought in" in the eastern Alberta natural gas field with an open flow of 19 million cubic feet daily.

According to the *Moscow Daily News*, a high-voltage laboratory capable of conducting electrical tests up to 2,000,000 volts—stated to be the first of the kind in Russia—is at present in course of construction at the Electro-physical Laboratory in Leningrad.

Two new oil storage schemes are announced from Canada. At Fort William, Ontario, four tanks of 2,500,000 gallons capacity, are to be put up by the McColl-Frontenac Oil Company, while the Imperial Oil Company intends to build a large depôt, with fifteen tanks, near the new docks at Churchill, Manitoba.

Dredging of approximately 3 million cubic yards of earth in a cut-off for the Mississippi River across the Diamond Point peninsula, 15 miles below Vicksburgh, Miss., to shorten the man stream channel by 10 miles and lower flood time back water levels 2ft. or 3ft. has been begun. The work is to be finished this year.

The Short "Kent" flying-boats (four Bristol Jupiter X-FBM) "Scipio," "Sylvanus," and "Satyrus," that have been in Imperial Airways' service in the Mediterranean since May, 1931, had covered up to the end of August last 98,720, 90,866, and 77,434 miles respectively (a total of 266,319 miles) without suffering a single mechanical breakdown resulting in the interruption of the scheduled service.

On Wednesday, October 26th, there were congregated in Southampton the seven largest British liners. They comprised, with their gross tonnages appended in brackets:—White Star: "Majestic" (56,621), "Olympic" (46,439), and "Homeric" (34,351). Cunard: "Berengaria" (52,226), "Aquitania" (45,647), and "Mauretania" (30,696), and the Canadian Pacific: "Empress of Britain" (42,348).

When the 75,000-ton French liner "Normandie" is launched at St. Nazaire on October 29th, the preliminary speeches (in French) at the banquet to precede the launch will be broadcast from the Poste Parisien station. There will be broadcast, from the P.T.T. (Paris) station, a running commentary both in French and in English of the actual launch and the scenes accompanying it. There will also be from that station a special short-wave transmission that will be relayed throughout America from some fourteen stations.

The British Columbia Department of Mines at Victoria, B.C., has forwarded to the Reference Library, Canada House, Trafalgar Square, London, S.W.1, a memorandum dealing with investigations conducted recently at the Mines Branch laboratories of the Dominion Department of Mines at Ottawa in respect to magnetite iron ore mined at Texada Island off the British Columbia coast. According to the memorandum in question, research work carried out during the past two years has shown the suitability of Texada Island magnetite for the manufacture of sponge iron. The fact that the production of sponge iron lends itself to comparatively small-scale operations suggests, furthermore, that the establishment of a sponge iron industry in British Columbia might be more economically feasible at the present time than the conventional blast-furnace open-hearth steel plant. The Mines Branch experiments have demonstrated the practicability of producing sponge iron from the ores in question, and that large-scale operation could probably be conducted successfully.

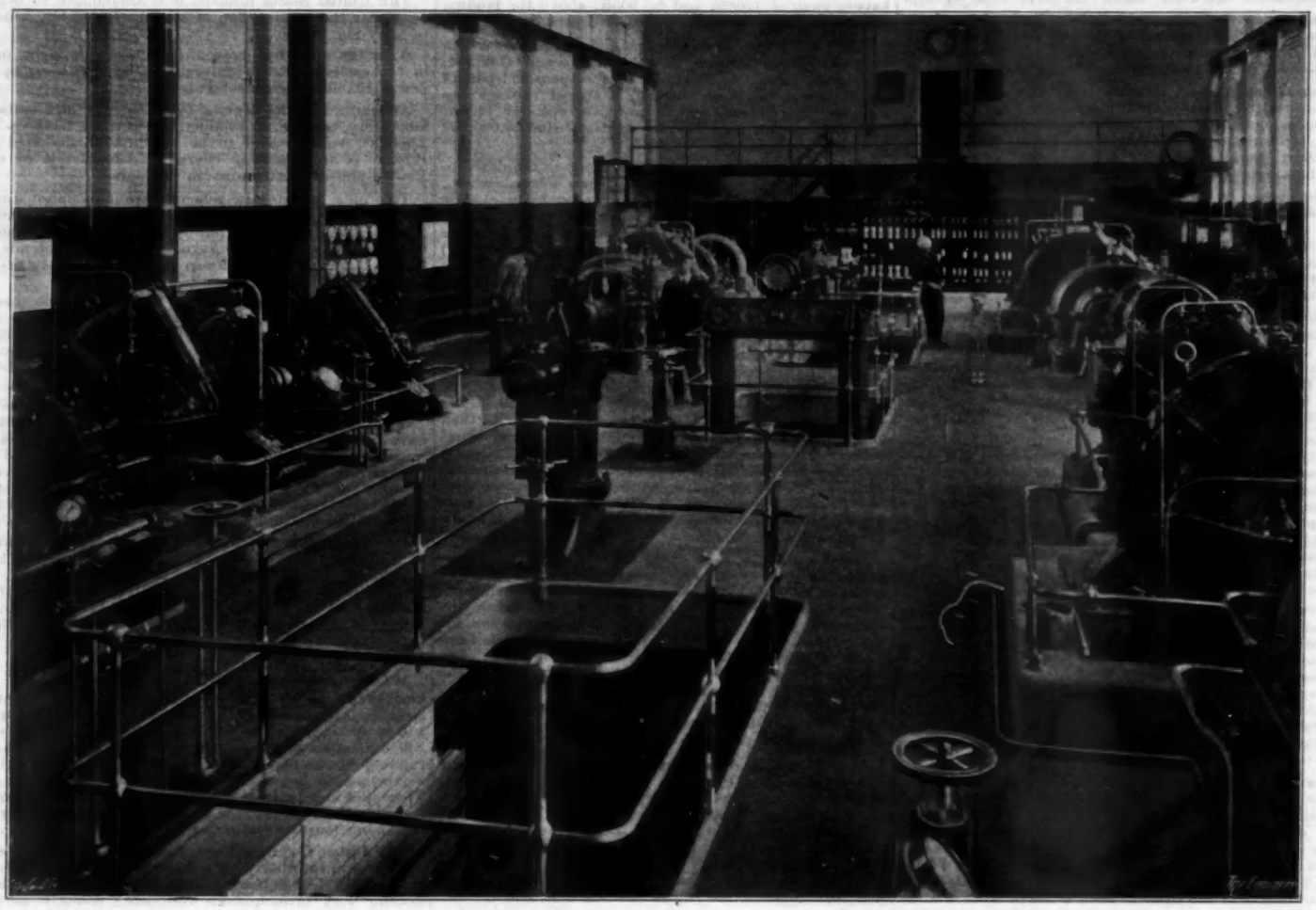
The Department of Scientific and Industrial Research has issued recently a brief pamphlet on the use of British Columbia Douglas fir for structural design. This timber is probably the most important source of softwood structural timber in the Empire. The pamphlet draws attention to the important developments that have taken place within the last few years in the grading of structural timbers in Canada. These new grades are marketed under the name "Ukay Merchantable." The dimensions of the cross section of any piece of the new grades are in each case ¼in. less than the nominal size of the foreign red or yellow deal with which the timber competes. Figures, obtained at the Forest Products Research Laboratory at Princes Risborough, are given in the pamphlet, which bring out clearly that as the result of the greater fibre strength of the Canadian timber, the dressed sizes are considerably stronger than the full-size piece of red or yellow deal. Besides being stronger, the timber is also stiffer than its foreign competitors. The pamphlet is published by H.M. Stationery Office, price 6d. net.

That flexibility of outlook which characterises our leading shipbuilding and engineering firms in the present period of shipbuilding depression, is well illustrated in the brochure entitled "Stationary Diesel Oil Engines," which has just been issued by Harland and Wolff, Ltd. The brochure is, in many ways, a companion to that issued some few months ago dealing with reversible trunk-type, four-stroke engines. It is comprehensive in nature and covers some twenty-two pages. An introduction discusses the advantages of stationary oil engines built on the Harland-B. and W. system, and this is followed by a standard specification. A further section deals with approximate particulars of rating data and overall dimensions, for different types of units, and is illustrated with outline dimensional sketches. The capacities of air bottles and silencers are tabulated, and there is also a section giving general information, which includes a specification for both lubricating and fuel oil, with notes on water cooling supply, &c. Finally, there is a table showing the large range of heavy-oil engines manufactured by Harland and Wolff, which now embodies the experience of many years, embracing land as well as marine plants. We understand that the brochure will be shortly followed by a similar publication dealing with oil-electric traction installations.

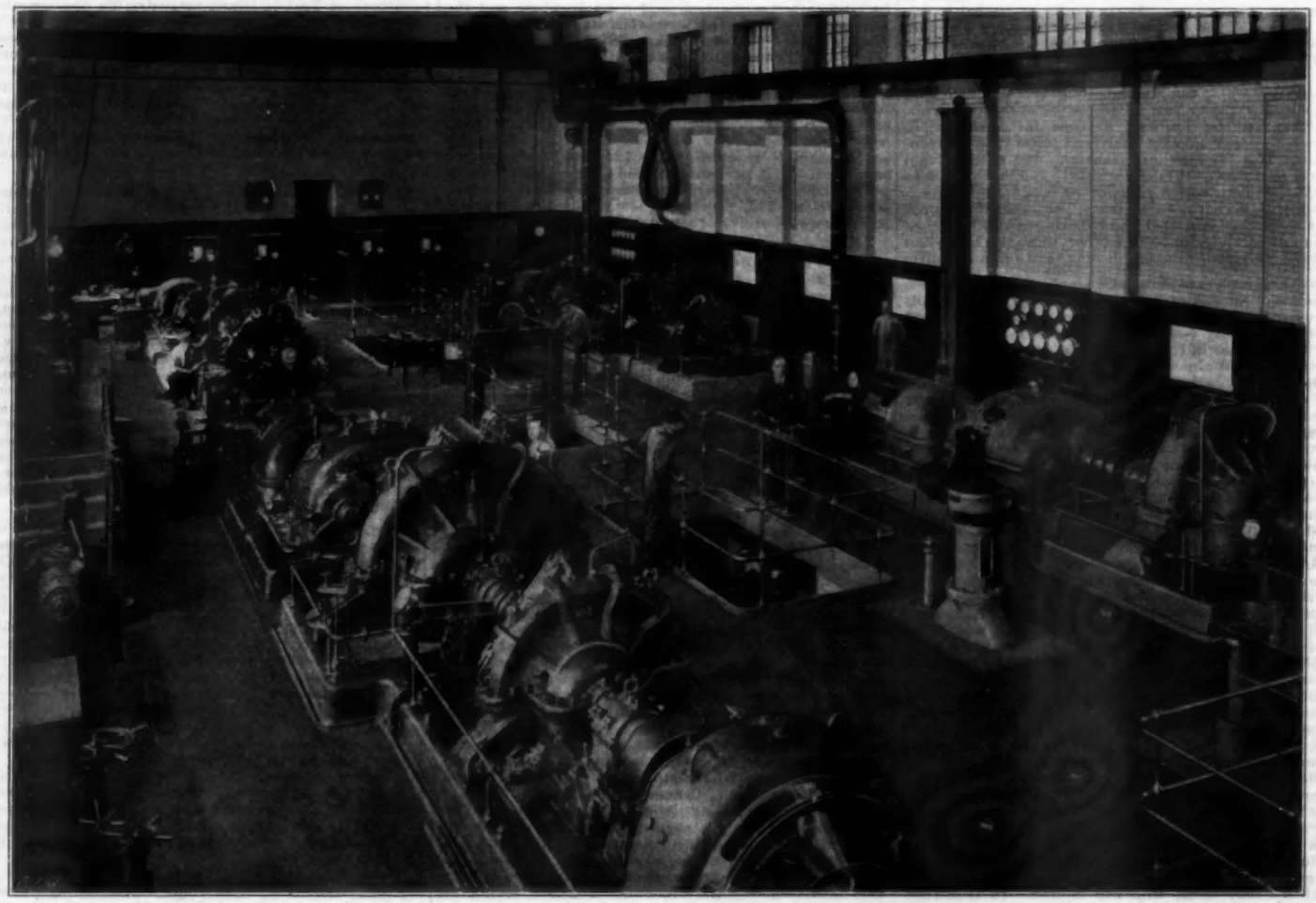
TURBINE PUMPING MACHINERY AT SURBITON WATERWORKS

MR. H. E. STILGOE, C.B.E., M. Inst. C.E., ENGINEER

(*For description see page 428*).



THE FOUR TURBINE-DRIVEN PUMPING SETS



THE PUMPING SETS CONNECTED WITH ELECTRIC GENERATORS

The Engineer

OCTOBER 28, 1932.

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NOTICES TO READERS.

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The Metallurgist.

THE OCTOBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

With and after the issue dated November 4th, "The Engineer" will be published on Thursday afternoons and will therefore be available in London and the Provinces on Friday mornings. Owing to the ability to catch an earlier mail, foreign readers will obtain their copies in many cases a week sooner than at present.

BRITISH AND FOREIGN WARSHIPS.

If the general public pays attention to such matters, it must be feeling rather perturbed by the reports which have been circulated about the remarkable powers of certain foreign warships, now in service or building. Taken at face value, they suggest that the British Navy has nothing to set against the formidable vessels which are being produced abroad. In our opinion, however, these reports are exaggerated, and we propose to give some reasons for taking this view. There never has been a time in our naval history when British men-of-war were not compared disadvantageously with those of foreign design. In the eighteenth century it was a constant source of complaint that our battleships and frigates were slower and less handy than their French rivals. Much of this criticism appears to have been well founded, for it was notorious that the fastest sailers in the Navy of those days were either prizes taken from the enemy or British-built ships based upon French designs. The habit of mind thus engendered persisted into the ironclad era. A search of our own files reveals a great many notes and comments relating to comparisons between contemporary British and foreign fighting ships in which the tendency to exalt the latter at the expense of the former is very marked. To take a few examples at random. The "Warrior" was compared unfavourably with the "Gloire," although by every test the British iron-built ship was superior to the wooden Frenchman; the "Devastation," "Thunderer," and "Dreadnought," our first mastless turret ships, were considered by some domestic critics to be incapable of holding their own against the Russian "Peter the Great," though eventually the latter proved to be a failure. In the 'eighties and 'nineties the appearance of the Russian belted cruisers not only raised a scare in this country, but saddled the British Navy with a fleet of large and expensive ships, designed as "replies," whose cost was wholly disproportionate to their value. Admiralty Boards of a past generation appear to have fallen easy victims to the form of mental suggestion expressed by the ancient tag, *Omne ignotum pro magnifico*. As taxpayers, we may be thankful for the more sober judgment of contemporary foreign naval design implicit in our current building policy.

In the Press reports to which we have referred special emphasis is laid on the remarkable qualities of the German "Deutschland" class, the so-called "pocket battleships," of which the first is nearing completion, whilst the second and third are on the stocks. It has been publicly stated, for instance, that "six of these ships could engage and defeat the whole of the British surface Navy." The absurdity of such a statement is not difficult to demonstrate. The "Deutschland," it will be remembered, is a vessel of 10,000 tons, propelled by internal combustion engines, carrying as main armament six 11in. guns in triple turrets. Six "Deutschlands," therefore, would bring into action thirty-six 11in. guns, with an aggregate broadside discharge of 24,120 lb. To this artillery the British Battle Fleet, consisting of fifteen capital ships, could oppose one hundred 15in. and eighteen 16in. guns, with a total broadside of 236,298 lb. In weight of fire it thus enjoys an almost tenfold superiority. The "Nelson" and "Rodney" together discharge a broadside of 44,298 lb., or nearly double that of six "Deutschlands." Although such comparisons are not an infallible test of relative fighting power, we think that in this case, other things being equal, there is no occasion for panic. It is true that a phenomenal range is claimed for the new German 11in. gun, but there is little doubt that all the heavy guns in the British Fleet are capable of delivering their fire up to any range at which hitting is practicable. We are frankly sceptical about the value which in some quarters is attached to naval gunnery at abnormal ranges. When every allowance is made for recent improvements in fire-control, the chances of hitting at any distance above, say, 25,000 yards, are not such as to justify the expenditure of ammunition. That, at least, is the opinion of almost all the gunnery experts known to us. Another statement published in the Press credits the "Deutschland" with a speed of 30 knots and a cruising radius of 20,000 miles at 20 knots. According to German official figures, the designed speed is 26 knots and the radius at 20 knots is 10,000 miles. Even these figures are to some extent speculative, for the first "Deutschland" has yet to run her trials, and both in general design and machinery she constitutes a bold experiment which may or may not prove successful. We yield to none in our admiration for German technical prowess, but we observe that it is not so much the designers of the "Deutschland" who claim for her these well-nigh fabulous powers as the foreign commentators who are concerned about the effect which the advent of this new type may have on the balance of power at sea. An obvious weakness of the "Deutschland" is her light protection. Although much ingenuity is understood to have been displayed in localising the effects of medium shell and of torpedo or mine explosion, it is clear that she can have only thin armour-plating on her sides and decks. She must, therefore, be extremely vulnerable to heavy gunfire, and would, in all probability, be disabled, if not sunk outright, by one salvo of 15in. shell. Further, the alarmists appear to forget that we have three ships—"Hood," "Renown," and "Repulse"—which are several knots faster than the "Deutschland," besides carrying more than twice her weight of armament. Owing to their much greater size and length they would be able to maintain a high speed in conditions of weather that would seriously handicap the "Deutschland." On the whole, then, while the "pocket battleship" has introduced a new and disturbing factor into the naval situation, it is not one calculated to prejudice the position of the British Navy—not, at any rate, in the near future. Some apprehension may also have been aroused in the public mind by reports of the extraordinary speed performances of foreign cruisers and destroyers, several of which are said to have exceeded 40 knots. While we accept such figures when published on good authority, we do not see any particular cause for envy, still less for alarm. The British Admiralty, whose fund of war experience is by far the richest, has deliberately refrained from building naval "sports models" which have no apparent *raison d'être*. It gives priority to strength of construction and seaworthiness. Throughout the Great War our ships of every type proved able to achieve, and often to exceed, their designed speeds. This was not always the case with vessels under other flags. It is no disparagement of contemporary foreign construction to suggest that the impressive trial speeds so often broadcast nowadays are not necessarily indicative of the performance of the vessels in question under ordinary conditions. Conversely, it does not follow that the less sensational trial figures of British cruisers and destroyers represent the maximum of which these ships are capable. When a British warship is undergoing trials the Admiralty will not countenance any forcing of the machinery. Were it otherwise there would, we think, be no difficulty in establishing "records" quite as imposing as those which are being claimed by friendly rivals abroad. As we were able to announce in a recent issue, the new destroyer "Daring" reached 38·2 knots on her official trials, although designed only for 35½ knots. Indeed, as far back as 1917 the destroyer "Teazer" steamed at over 40 knots with her full war equipment on board. If, therefore, our latest craft are inferior in paper speeds to foreign vessels, this is due entirely to policy, not to any shortcomings on the part of our constructors or engine-builders. There is, in fact, a marked and growing disposition in British naval circles to question the value of very high speeds. By limiting the designed velocity to 30 knots, hundreds of thousands of pounds might be saved in the cost of every new cruiser, without, in the opinion of many experienced officers, detracting in any way from its general efficiency.

While there is unquestionably some scope for reform in our naval construction policy, we believe it to lie in the direction of simplifying design and reducing costs, rather than in imitating foreign types which appear to be quite unsuited to British requirements.

Progress and Exaggeration.

In the concluding sentences of his Presidential Address to the North-East Coast Institution, Mr. R. J. Walker sets down a proposition which has, we think, escaped proper recognition hitherto. "I should like," he says, "to offer a word in regard to claims made for any new idea or improvement or advancement of existing equipment. In the main, such claims have been substantiated, but occasionally we hear of instances where the advocates of new ideas in regard to the ship or her machinery have been prone to exaggerate their value to the shipowner. Probably nothing retards progress more than a failure to achieve within reasonable limits claims which may have been made upon a hypothetical basis, or upon a comparison with out-of-date practice. We have in this country many progressive shipowners who are ever ready to adopt some new idea of proved value, and in the advocacy of these ideas it would be well that we should observe that sense of proportion which would carry conviction to the shipowners for their adoption, and, in the issue, retain their confidence."

With the exaggerated faith of the inventor we are all familiar. Oftentimes he needs it, for without it he is unable to move that mountain of money which is necessary for the materialisation of his ideas. History shows that in numerous cases it is his ability to convince financiers that large profit may be made that turns the scales. But, whether or not the inventor himself be guilty, once the invention has passed into the hands of the company promoter, the sense of proportion to which Mr. Walker refers flies out of the window. The promoter's object is to get a "good Press," to influence public opinion, and to touch people's pockets. His appeal is often enough an appeal to the gambling spirit. He exaggerates claims and supports them by assertions and comparisons that are either wholly false or will not bear scientific analysis. The company passes through several interesting stages, at each one of which the promoter and his friends take comfortable profits out of the subscribers. In the end the invention may prove to be sound and reasonable; alternatively, its fallacies may be revealed by scientific

and economic examination and experience. Then the shareholders lose their money. But they do not blame themselves or the promoters; they accuse manufacturers of indifference to their own advantage, of premeditated murder of the invention because it would interfere with the tenor of their business. Unfortunately, such accusations may be supported by many examples, but the fact that numerous useful inventions are every year adopted by industry should be sufficient evidence that the indictment is not generally true; as so often happens, the exceptional attracts more attention than the general. Whilst we should be glad to see British engineers more ready than they are to give full trial to every British invention which holds out some prospect of success, and whilst we regret that they so often adopt foreign patents, we cannot deny that their attitude is the outcome of costly experience and that their caution and scepticism are the virus left in them by the bites of "mad inventors" and their associates. Their timorousness, as Mr. Walker hints, is, in many cases, the direct outcome of exaggerated claims, and it may be suggested that if the promoters of new inventions would present them with more moderation they would be more likely to receive sympathetic hearing. One of their common failings, as Mr. Walker points out, is to make "comparison with out-of-date practice." There are endless examples of inventions which appeared to show remarkable advantages when tested under certain conditions, but when subjected to other conditions, either physical or economic, exhibited no material superiority over the best existing practice. Others, again, even more numerous, are founded upon what Mr. Walker calls a "hypothetical basis." Inventions of this kind present the engineer with the most difficult problem, for he has to decide from paper estimates whether the expense, often great, that will be necessary to test them on a sufficiently large scale will be justified. And when his preliminary experiments have been made and have, as almost invariably happens, revealed weaknesses, he has to make the very critical decision whether the prospects of ultimate success are sufficiently good to warrant the further expenditure of time and money. If that problem involved no other factor than the technical merits of the invention, it would generally be relatively easy. Unfortunately, numerous economic questions intrude themselves, and in many instances turn the scale against something which is technically sound; for it does not follow that because a thing can be done it is worth doing. On the other hand, it is not seldom the case that something which has little or no technical advantage is worth doing commercially—it may, for example, provide the merchant with his dearly loved "selling point." Usually, the manufacturer is the best judge in such matters, and for that reason the bulk of successful inventions for improvements emanate from the works themselves, whilst the great primary inventions are generally due to an independent person.

The attractiveness of a subject which presents so many facets and appeals to so many people has drawn us a little away from Mr. Walker's proposition, but we submit that, in showing the difficult road which the practical development of inventions must follow, we have given support to his contention that a sense of proportion should be preserved in presenting claims. "Hope deferred maketh the heart sick," and when Mr. Walker writes that probably nothing retards progress more than failure to achieve claims within reasonable limits, he means, no doubt, that the discouragement which results makes the manufacturer, or the owner, in the case of ships and factories, chary about spending his money on another occasion. His confidence in inventors and inventions is weakened, and he is less ready to listen to new proposals than he would be had his anticipations not suffered shipwreck. It is a good point, one which not only inventors themselves, but even more, those who endeavour to promote inventions, would do well to bear in mind. A moderate result from a moderate claim will give encouragement; a moderate result from an exaggerated claim will cause disillusion and disappointment.

Institution of Electrical Engineers.*

As electricity is the ultimate constituent of the atom, electrical engineering is therefore the most fundamental engineering of all, because it deals with the practical methods of controlling these particles. It has the whole world for its domain. The practical advances which have been made possible by the discovery of the electron and the proton cannot be forecast. Although they are becoming increasingly important in electrical engineering, the study of their structure and behaviour is still largely the domain of the physicist. The wisdom of making it easier for physicists to become members of the Institution is thus becoming more apparent every day.

It is to the lasting credit and benefit of electrical engineering that over thirty years ago the Institution, recognising that physics was the key to its future progress, fostered the Physics Section of *Science Abstracts*. There are some who ask why electrical engineers should have the responsibility of maintaining that section. The answer is that there is little money in physics itself. There is no "industry of physics" to take the financial responsibility for such an essential publication. It is only when physics is applied to electrical engineering that it becomes profitable and can support a publication consisting of abstracts for the assistance of workers in physics in connection with those investigations which, to-morrow, will be the newest activity of the electrical engineer.

Electrical engineering has been peculiarly fortunate owing to the fact that the industry began at the scientific end. In this respect it was not like mechanical engineering. Ohm's law was understood before a house was supplied with electric light or a factory with electric power, whereas the steam engine was invented years before the second law of thermodynamics had been enunciated. For this reason the importance of scientific study in connection with electrical matters has always been more fully recognised.

Electricity in Medicine.

There is another use of electricity in which some members of the Institution have taken great interest, namely, the use of electricity in medicine. It is interesting to recall that two of the pioneers of electrical engineering, Volta and Galvani, were physicians. Nowadays, electricity is used in medicine not only for giving therapeutic treatment, as, for example, high-frequency treatment and X-ray treatment, but it is of special value for recording the effects of disease in the human body.

Physiologists have shown us during the last half century that every muscle and nerve is the source of an electric current. One of the most powerful muscles in the body is the heart, and Dr. Waller, of University College, London, demonstrated over twenty years ago that the heart produces currents which can be recorded if the hands are connected to a suitable instrument. By making use of this appliance it has been possible to study the condition of the heart far more exactly than was possible to the older practitioner.

The engineer and the doctor are complementary in the sense that the more the engineer is allowed to do, the less the doctor will have to do; but the electrical engineer can assist the doctor in other ways, and in no way more than by providing the physician with appliances which will enable him to diagnose more accurately the diseases of the human body. Perhaps the most notable change that has come about during the last thirty-five years has been the possibility of seeing inside the human body. The discovery of X-rays marked an epoch in diagnosis and has given to the operations of the surgeon a precision which is of incalculable benefit. The link between the electrical engineer and the doctor is becoming closer, and before long we may reasonably expect that the Institution will find it necessary to establish a section dealing with the applications of electricity in medicine.

Co-operation Between Engineering Institutions.

It is obviously a great advantage to the electrical industry that all engineers occupied with the production and sale of electrical apparatus and electrical energy should form one great guild, *i.e.*, the Institution of Electrical Engineers. The electrical engineer provides one of the most vital services of our modern civilisation, and all engaged in this great service should work together to maintain and improve it; but I would go further and suggest that the time is not far distant when electrical engineers, mechanical engineers, and the venerable civil engineers should attempt to form one greater guild, the nucleus of which exists already in the Engineering Joint Council.

In the universities we are faced with the problem of training all kinds of engineers in the scientific principles of their profession. When they first come to the university all prospective engineers take a common course for one year or, in some cases, two years. They have first of all to show themselves competent to write their own language and to express themselves clearly and intelligently. That is a qualification which every educated man should have. They must be able to calculate. They must know something about the principles of mechanics and physics. These subjects are common to all engineers, and it does not seem beyond the bounds of possibility that this should be recognised by having a common standard of entrance, so that a man who has qualified to enter on a course of training as a civil, mechanical, or electrical engineer, or as a naval architect, should possess a qualification which will enable him to enter any of these institutions as a student member.

From the point of view of the Institution there is a great deal to be said for a very careful selection of student members, and if there is to be closer co-operation between the different engineering institutions this question will, I think, have to be faced. I am glad to find that another kind of co-operation is being adopted to an increased extent this year by our own Institution, namely, the reading at joint meetings of papers which are of interest to members of more than one society. This practice has been followed by many of the local centres, has greatly increased the general interest in the papers, and has provoked very vigorous discussions.

Unemployment and Leisure.

One of the great evils of the day is unemployment, and it is sometimes suggested that the labours of the electrical engineer increase the number of those who are out of work. There is, however, another side to this question. It is quite true that electrical methods have diminished the amount of manual labour in nearly every industry; on the other hand, electrical engineering has created more new industries than any other applied science. There are all over the world hundreds of thousands of people to-day employed in the manufacture of electrical machinery and electrical apparatus; there are also tens of thousands employed in the telegraph and telephone industry, in the business of supplying electrical energy, in the manufacture of electrical appliances, in the making of valves and lamps and cables, in the radio industry, and, within more recent times, in the supplying of equipment for producing talking films, who would never have found work had it not been for the researches of Faraday and his successors.

The Institution has welcomed these industries and has endeavoured to draw within its scope all those trained engineers engaged in them. With increased efficiency of production, the workers to-day have far more leisure than formerly, and one of the chief tasks of modern education is to enable them to make good use of it. In this respect the electrical engineering industry has given more practical service than any other. Although some people may criticise "wireless" and the "cinema," these undoubtedly provide entertainment and relaxation and give a vast multitude of people a much broader outlook on life than they could otherwise have had. The electrical engineer touches life on every side, and he has surely fulfilled, if anyone has ever done so, the function of an engineer which is laid down in the Charter of the Institution of Civil Engineers, for he has shown the world how "to adapt the resources of Nature to the use and convenience of man."

Many of you, no doubt, have read the profoundly interesting address which Sir Alfred Ewing delivered last month before the British Association, but I should like to quote a few lines of it. "So man finds this, that whilst he is enriched with a multitude of possessions and possibilities beyond his dreams, he is, in a great measure, deprived of one inestimable blessing, the necessity to toil. He has lost the joy of craftsmanship, the old satisfaction in something accomplished through the conscientious exercise of care and skill, and the world finds itself glutted with competitive commodities produced in a quantity too great to be absorbed."

Something has been lost, but the loss is not uncompensated. Knowledge, though sometimes misapplied, has become more accessible, and we have the possibilities of an increased leisure in which to pursue it. We have the incentive and the opportunity to acquire, through the assimilation of knowledge, right judgment and understanding.

* From the Presidential Address delivered by E. W. Marchant before the Institution of Electrical Engineers on October 20th.

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Education for Trades and Industries. By C. T. Millis, M.I. Mech. E. London: Ed. Arnold and Co., 41, Maddox-street, W.1. Price 6s. net.

Elementary Metallurgy for Engineers. By G. F. C. Gordon. London: Constable and Co., Ltd., 10–12, Orange-street, W.C.2. Price 8s. 6d. net.

Ohm's Law and Temperature-resistance Charts. By H. O. Cooper. London: Oxford University Press, Amen House, Warwick-square, E.C.4. Price 6d.

La Mort du Rail: La Renaissance Economique par l'Automobile. By M. de Coninck. Paris: La Librairie Valois, 7, Place du Panthéon. Price 5f. net.

Graphs of Standard Mathematical Functions. By H. V. Lowry, M.A. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 2s. net.

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The Anatomy of Modern Science. By B. Bovink, translated by H. Stafford Hatfield. London: G. Bell and Sons, York House, Portugal-street, W.C.2. Price £1 1s. net.

Methods of Test Relating to Electrical Insulating Materials, 1932. Philadelphia, Pa.: American Society for Testing Materials, 1315, Spruce-street, U.S.A. Price 1·25 dollars net.

Compte rendu Stenographique des séances de la troisième Semaine Internationale du Machinisme à la Ferme. Lausanne: Institut Internationale de Mécano-Culture Palais "Mon Repos."

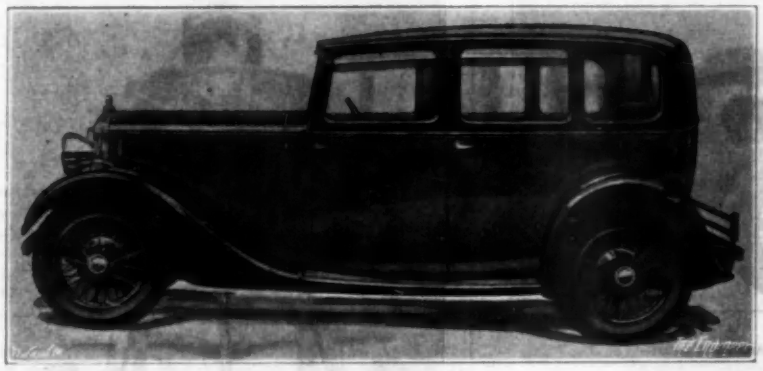
The Motor Car Show at Olympia.

No. III. (*conclusion*).*

Although one or two of the prineipal British motor manufacturers have been turning their attention to drastic improvements in transmission systems for some time, the Show at Olympia which was held last week will probably go down to history as being the first of the long series at which gear changing was of paramount importance, and further great strides can be anticipated in the near future. As an aid to easy gear changing the first serious attempt was made in 1926, when the free wheel made its appearance. This did not "catch on" in this country as well as it did in America, in spite of obvious advantages. The Armstrong-Siddeley pre-selective epicyclic system which made its appearance two or three years ago was at once successful, and there are others which are equally ingenious now available, such as the synchro-mesh mechanism, in which small cone clutches in the gear-box bring the gears which have to be engaged into synchronism. Then there is the Bendix automatic clutch mechanism, which relies on the engine induction system to withdraw and disengage the clutch. This depends on the use of the accelerator pedal. In the Salerni transmission, which is being taken up by one or two firms, a hydraulic coupling with a ring valve is used in front of the gear-box and a mechanical coupling behind the box. The control of the ring valve and mechanical coupling are connected and are operated by a pedal. By depressing this, moving the gear lever and releasing the pedal again the hydraulic coupling disconnects the gear-box from the engine and the other coupling disconnects it from the propeller shaft, the gears being then brought to rest by a band brake connected to the pedal so that rapid changes of gear can be made. Already a good percentage of British cars are being fitted with one or other of these gears and their progress will be watched with much interest.

Daimler.

An important departure from its customary practice in engine design has been made by the Daimler Company. In order to place on the market a medium-powered car with the fluid fly-wheel and self-changing transmission gear, this firm has had to resort to overhead poppet valves in place of sleeve valves. The 15 horse-power engine has six cylinders, with a bore of 63·5 mm., and a stroke of 95 mm., and develops 48 brake horse-power. It has a four-bearing crank shaft fitted with a vibration damper, a fully pressure-fed lubrication system, automatic carburetter, and coil ignition with automatic advance mechanism. The gear-box contains four gear ratios of the pre-selective type. The car has hydraulic brakes to all road wheels operated by pedal on the Dewandre-servo principle. Views of the 15 H.P. saloon and engine and gear-box are given in Fig. 14. Other exhibits by the Daimler Company included 20, 25, and 50 horse-power cars—the last named having twelve cylinders—all of which are, of course, equipped with the fluid fly-wheel and self-changing epicyclic gear-box.



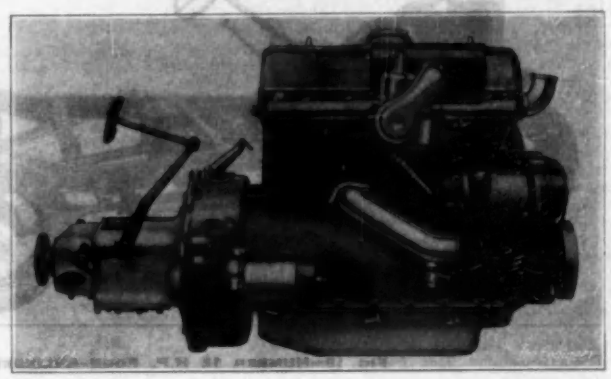


Fig. 14—Daimler 15 H.P. Saloon and Engine Unit

Austin.

The Austin Motor Company's 1933 programme includes two new models which will make a strong claim for popularity. These are a 10 horse-power four-cylinder and a light 12 horse-power four-cylinder car. The former has been on the market for some months, but was not on view at last year's Show. It has a four-cylinder monobloc engine with a bore and stroke of 63·5 mm. and 89 mm. respectively, a cubic capacity of 1125 c.c. and R.A.C. rating 9·996 horse-power. The engine has a detachable cylinder head, valves all on the near side, and pistons of aluminium alloy. Ignition is by coil and battery. It is cooled by thermo-syphon and fan and the lubrication is by an oil pump to all bearings of the crank and cam shafts, while chassis lubrication is by grease gun. The transmission is taken through a single dry plate clutch and the gear-box has four speeds with a "twin top" gear. A part sectional drawing of the gear-box is shown in Fig. 16. The brakes are of the expanding type acting on all four wheels and the steering is of the worm and worm wheel type. Long semi-elliptic springs, aided by shock absorbers, provide extremely good riding qualities. This saloon car is remarkably good value at £168.

Fig. 15—Austin 12 H.P. Four-Cylinder Engine

The light 12 H.P. four-cylinder car has a monobloc engine (Fig. 15) of 69·3 mm. bore by 101·6 mm. stroke, with a capacity of 1535 c.c., R.A.C. rating 11·9 horse-power, and giving 24 B.H.P. at 2400 revolutions per minute. It has a detachable cylinder head with all the valves on the near side, a crank shaft carried in three large bearings, coil and battery ignition, and fan and thermo-syphon cooling. The engine is mounted at three points on resilient rubber bushes to prevent vibration. Lubrication, following the usual Austin practice, is by forced feed from a gear type pump driven by skew gears from the cam shaft, the oil being fed to all main bearings through a pipe system. A pressure adjustment is provided on the near side of the engine. The carburetter, distributor, dynamo, starter, oil filler, dipstick, petrol pump, and valves can be reached for adjustment or attention without difficulty.

The clutch and transmission of this model follow "twelve-six" practice, as also do the chassis, brakes, suspension, and steering, and the gear ratios provided by the four speed twin top gear-box, in conjunction

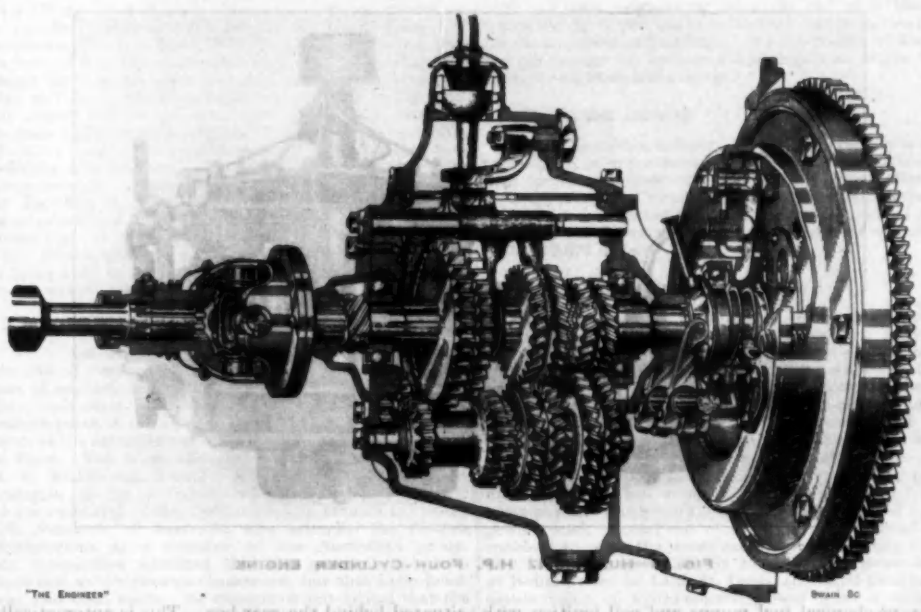


Fig. 16—Gear-Box Details of Austin 10 H.P. Car

* No. II. appeared October 21st.

with the three-quarter floating axle, are as follows: 20·8, 13·4, 8·6, and 5·5 to 1. A new feature consisting of a neat thermostat on the water circulation system is being fitted on the 1933 Austin 12 horse-power six-cylinder cars. This appliance, shown in

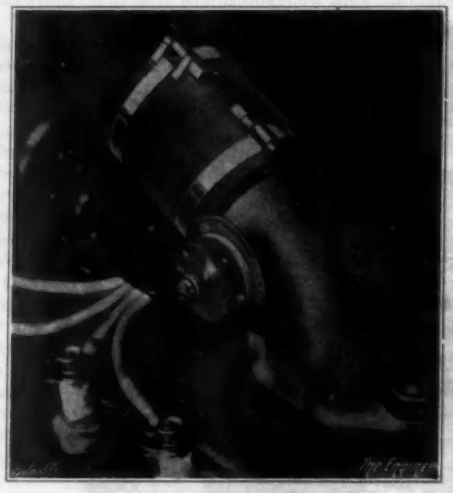


FIG. 17—AUSTIN THERMOSTAT

Fig. 17, will be particularly beneficial in cold weather for warming up the engine quickly.

HUMBER.

An addition to the existing "Snipe 80" and 16–60 models is being introduced by Humber, Ltd., in the form of a 12 horse-power saloon, Fig. 18, whose features

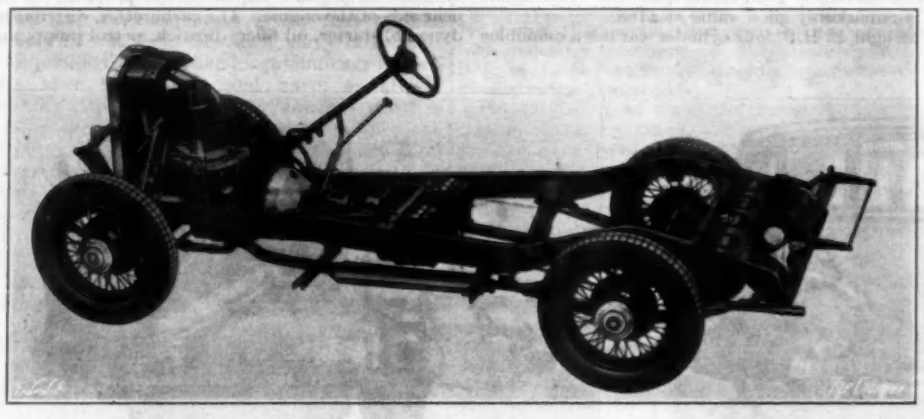


FIG. 18—HUMBER 12 H.P. FOUR-CYLINDER CHASSIS

include a four-cylinder engine, Fig. 19, with a bore and stroke of 69·5 mm. and 110 mm., giving a cubic capacity of 1669 c.c. and a rating of 11·98 horse-power. This new engine has a three-bearing crank shaft with balance weights forged integral with the

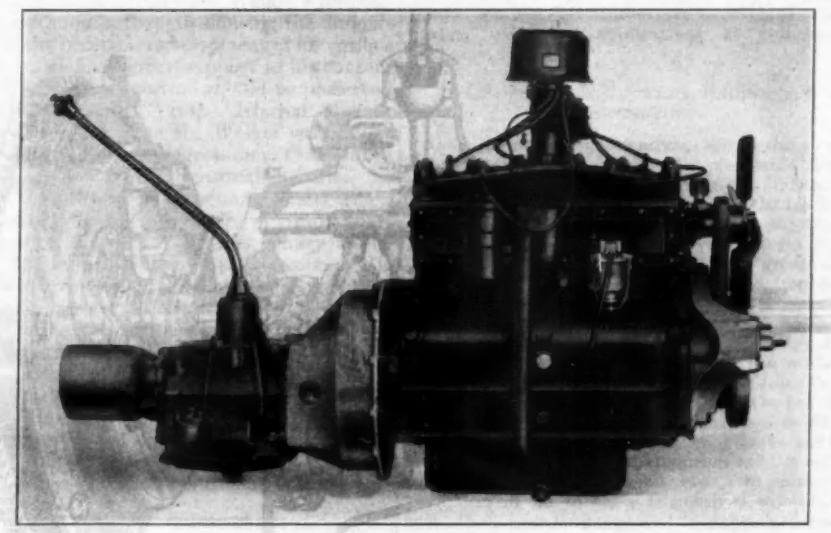


FIG. 19—HUMBER 12 H.P. FOUR-CYLINDER ENGINE

webs, mechanical fuel pumps and coil ignition with automatic and manual advance. The engine and transmission system are cushioned and the gear-box has four speeds, including a silent third. The chassis frame is of deep section and is cross-braced diagonally, while the springing is assisted by automatically controlled shock absorbers. The brakes on all four wheels are of the self-energising duo-servo type, acting on 10in. drums and separately operated on all wheels by both hand and foot levers. The saloon body provides full accommodation with ample leg room for four adults. The "Snipe 80" and the 16–60 H.P. cars have six-cylinder engines, with seven-bearing crank shafts balanced statically and dynamically. The shafts are fitted with vibration damper and balance weights forged integral with the webs. Cyclonic induction gives a quick acceleration when starting either hot or cold.

WOLSELEY.

Of prominent interest among the seven Wolseley models on view was the new "Sixteen," Figs. 20 and 21, of which the engine is mounted forward after the manner which was introduced on the Wolseley "Hornet" last year. This car and the "County" types have the new sealed bulkhead arrangement of isolating the engine from the body. All models except the "Hornets" have a free-wheel device situated behind the gear-box. This is automatically locked when the reverse gear is engaged and, additionally, it can be locked at any time at will. The "Hornet," "Sixteen" and "County" models have Lockheed brakes, those of the long wheel-base types being vacuum servo operated. The

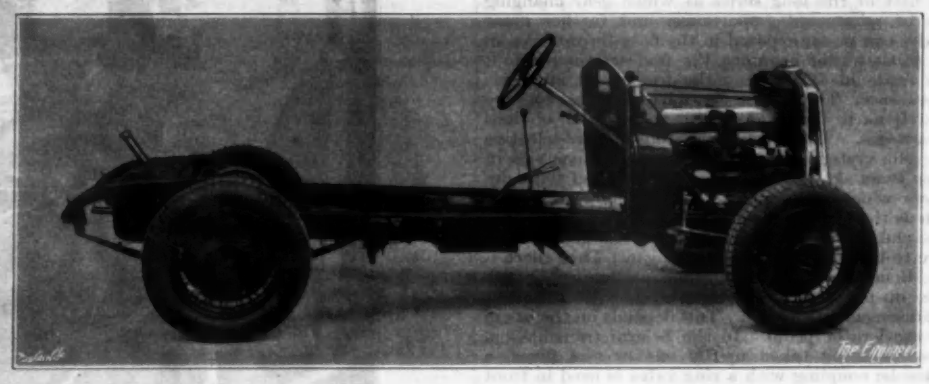


FIG. 20—WOLSELEY 16 H.P. CHASSIS

refinements which have been adopted on all models include centri-cast cylinder liners, centre-seal pistons, balanced steering, automatic starting, direction indicators combined with the number plates, dip and switch headlights, controlled spring shackles, stronger frames and transmission and larger brake drums. The engine dimensions of the "Hornet" have not been altered, the capacity being 1271 c.c. The overhead valves are driven by two-stage chains and the water is circulated by a centrifugal pump. The S.U. carburetter is fed by a petrolift from the rear tank, and a combined air cleaner, heater and fume extractor is a feature. The detachable Magna type wire wheels carry 27in. by 4·75in. tires. The Rover "Sixteen" is rated at 15·7 H.P., and the engine dimensions are 65 mm. bore by 101 mm. stroke. The general equipment follows closely on the lines of the "Hornet," but the Magna wheels are shod with 28in. by 5·25in. tires. The 21/60 H.P. "County" Wolseley car is rated at 20·93 H.P., and, like the other models, has overhead valves and

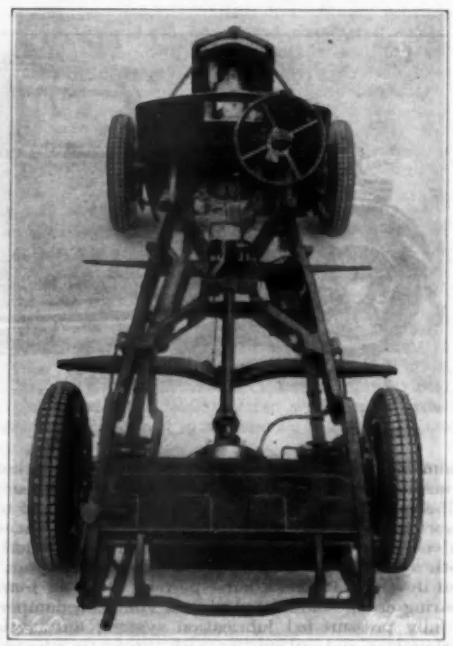


FIG. 21—WOLSELEY 16 H.P. CHASSIS

cam shaft operated by a two-stage chain drive. The wire wheels carry 28in. by 5·50in. tires, and the equipment includes two spare wheels. The saloon body, designed to seat five, is upholstered in hide and has a sliding roof and safety glass.

SCINTILLA.

The new "vertex" ignition system which has been evolved by Scintilla, Ltd., Clerkenwell-close, London, E.C.1, to replace existing coil ignition sets, is claimed to be foolproof and to operate independently of the battery. It is a meritorious attempt to combine in one unit the advantages of both magneto and battery ignition. The principle and construction of the Scintilla magneto, *i.e.*, rotating magnet, stationary armature, condenser, and contact breaker, have been adopted in this new device. It possesses the great advantage of being able to replace any existing distributor without alterations being necessary to the engine. It incorporates automatic spark advance, and produces a good and regular spark over the complete ignition range, 60–70 revolutions per minute on a four-stroke engine, the magneto being driven at camshaft speed. The sectional illustration, Fig. 22, shows the construction of this magneto. The rotating permanent magnet 1 of cobalt steel produces magnetic lines in the pole shoes 2 and 3. The circuit is closed by the core pieces 4 and 5. The alternating

flux flows through the core of the coil 6 and induces a low-tension current in the primary winding 7. The sudden interruption of the primary current caused by the opening of the contact breaker points induces a high-tension current in the secondary winding 8, which is transmitted by the cable 9 to the central contact of the distributor head 10. From the distributor rotor 11 the high-tension current passes through the electrodes 12 to the high-tension leads, and subsequently to the sparking plugs.

The contact breaker assembly is mounted on a base plate 13 and consists of a rocker arm 14, fixed contact point carrier 15 and a cam 16. This assembly is situated in the top part of the housing, and is easy of access for inspection. The cam is fitted to the rotor spindle 17 and is surrounded by an oil protection housing which has an oiling wick for lubricating the cam. The condenser 18 connected in parallel with the contact points eliminates the sparking and burning

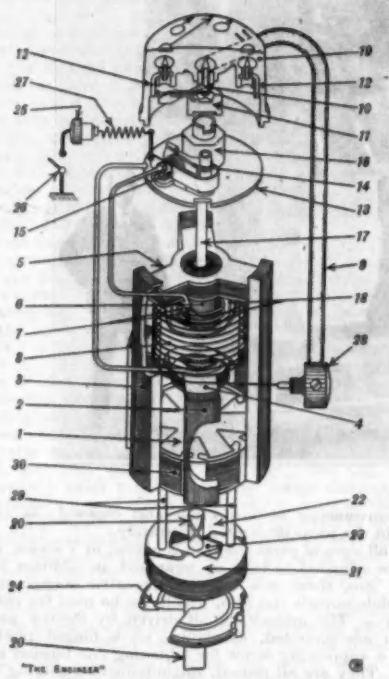


FIG. 22—SCINTILLA MAGNETO

of the points. It is placed between the primary and secondary windings 7 and 8, and is therefore not affected by any external influence. The distributor head 19 is held in position by two springs, rendering the whole unit dust and waterproof. The permanent magnet with automatic advance rotates on the bearing of the driving spindle 20. The poles of the four, six and eight-pole rotors are polarised alternately. The automatic advance mechanism requires no springs. The two packs of governor plates 21 and 22 consist of laminations with varying shapes and weights. Owing to centrifugal force, the governor weights tend to move outwards, and as their movement is checked by the cam 23 on the driving shaft, the contact breaker cam secured to the rotor spindle 17 automatically advances, and as the speed increases the respective centrifugal plates reach the limit of their travel and are put out of action. It is claimed that as there are no springs, the range of advance always remains constant.

The dimensions of the driving shaft of the apparatus are identical with those of battery ignition distributors. The rotor is coupled to the driving shaft by means of the automatic advance device. The shaft runs in two plain bearings in the housing, and is also provided with a friction brake 24 to counteract shocks. The short-circuiting terminal 25 on the side of the housing is connected to the ignition switch 26 on the switchboard, and a resistance 27 is fitted between the short-circuiting terminal 25 and the primary winding 7, to obviate the possibility of demagnetising the magnet if a current should be accidentally passed to the magneto. It will be seen that no gear wheels are employed.

OTHER CARS.

Amongst other cars which must be mentioned, but to which we can devote but little space, are the "M.G.," which has four 57 mm. by 83 mm. cylinders cast *en bloc* with the upper part of the crank chamber in chromidium cast iron and aluminium pistons; the "Singer" 9 H.P. saloon, a cheap car, with a four-cylinder 972 c.c. engine; the "Armstrong-Siddeley" 12, 15, and 20 H.P. cars, which are fitted with a permanent jacking system to facilitate wheel changing and, in the larger sizes, with the Daimler fluid fly-wheel; the new "Invicta" 12 H.P. car, which can do over 60 m.p.h. with four people up; the "Talbot" range of cars from 13·8 to 20·9 H.P. with six chromidium cylinders, dynamotor drive and self-changing gear-box; the new 9 H.P. "B.S.A." car, with 1075 c.c. cylinders, which is notable on account of its front wheel drive; the "Trojan," which has changed but little from this year's design, the vertical two-stroke four-cylinder engine being retained, but an automatic clutch being now provided to enable it to run freely regardless of the position of the change speed lever; the "Vauxhall" six-cylinder "Cadet" with an R.A.C. rating of 16·9 H.P.; the 16 and 20 H.P. "Sunbeams," which have called for little alteration, the most notable improvement being the inclusion of a synchro-mesh twin-top gear-box, which ensures ease in gear changing and obviates double declutching; the "Jowett," which retains the 7 H.P. two-cylinder horizontal engine, but which is now mounted on rubber cushions; the "Riley" range of cars with six and four-cylinder units, on which the Salerni fluid clutch will be available in next year's models; and last, but not least, the "Rolls-Royce," which in next year's models will include a gear-box on the synchro-mesh principle with four speeds and a silent third.

Canadian Engineering News.

(By our Canadian Correspondent).

Bridges in Quebec.

THE province of Quebec's extensive highway bridge building programme, for which a sum of 8,000,000 dollars was provided by the Legislature some time ago, is well under way. Several of the bridges are already completed and the others, with the exception of the structure over the St. Lawrence River at Caughnawaga, for which tenders will be invited shortly, are well on the way to completion.

Electric Railways.

The extent to which electric railways have fallen behind in Canada is shown by a Government report for the year 1931. As compared with 1930, there was a decrease of 72,233,132, or 9·1 per cent., in the number of passengers carried, whereas the decrease in 1930, compared with 1929, was 40,795,373 passengers, or 4·9 per cent. None of the tramways showed an increase in 1931, and decreases for the larger systems ranged from 4·2 per cent., for the British Columbia Electric, to 18·5 for the Calgary municipal system. Three electric railways ceased operations during the year, a fourth was taken over by a steam railway, and there was a total decrease of over 115 miles in operating lines. Out of a total of fifty-two systems, twenty failed to earn operating expenses.

Large Oil Refinery.

The Shell Oil Company of Canada has begun work on the erection of a new 2,000,000 dollar oil refinery in Montreal East. The refinery is to have an initial capacity of 100,000 gallons of petrol per day in addition to other products. Plant construction will include five tanks of 4,130,000 gallons capacity each, believed to be larger than any yet built in Canada.

Bitumen for Rubber Manufacture.

Extraction of bitumen from the deposits of tar sands in Northern Alberta for use in the manufacture of rubber in Canada has been made possible. The tar sands cover an area of more than 6000 square miles and the product is now being tested on a large scale in one of the Canadian rubber factories.

The New Observatory.

Work is to commence immediately at Richmond Hill, Ontario, on the second largest telescope in the world. An administration building will cost in the neighbourhood of 125,000 dollars, while the greater part of the cost involved—500,000 dollars—will be devoted to the erection of a circular building, 61ft. in diameter, to house the huge telescope, virtually all of which is now being constructed at the works of Sir Howard Grubb, Parsons and Co., Newcastle-on-Tyne, England. The mirror alone weighs 5000 lb. The two buildings will be situated in the centre of a 177-acre plot of land. The round building will be on a circular platform 800ft. above sea level, while the administration building will be on a level 5ft. below and in front of it will be an area 3ft. lower still. The telescope, larger than the one in the Dominion Government Observatory at Detroit, British Columbia, is of the reflecting type. Its mirror will have a clear aperture of 74in., and will be fashioned from a disc of glass 76in. in diameter and 12in. thick. In one of the smaller domes in the administration building it is proposed to mount a 19in. reflecting telescope recently constructed at the University of Toronto by Professor R. K. Young, while, in the other smaller dome, there will be three astronomical cameras on a single mounting. In the central dome it is hoped to mount a 10in. telescope of the refracting type. The Observatory is being built as a memorial to the late David A. Dunlap, by his widow, Mrs. Jessie Dunlap.

Empire Research.

Nations of the Empire should get together with the idea of working hand in hand in regard to the application of scientific research, and the good that could accrue from such team work would be as valuable to the component parts of the Empire as the economic basis agreed upon at the recent Imperial Conference will prove valuable to them. This is the thought uppermost in the mind of A. E. Richardson, Director and Professor at the Waite Institute of the University of Adelaide, and member of the executive of the Commonwealth Council for Scientific Research, of Australia, who attended the Ottawa deliberations as a member of the Australian group. Mr. Richardson admitted that the question had been broached at the Ottawa Conference, but that little headway had been made. He thought it but logical that the United Kingdom, Canada, Australia, and the other nations of the Empire should work in harmony and co-operate in the application of scientific research, expressing the belief that many research problems now considered as being of national import solely are actually matters of Imperial significance.

New Work for Vickers.

The Moore speed crane, a product of the Manitowoc Engineering Works of the United States, is to be manufactured in Canada by Canadian Vickers, Ltd., Montreal, and a complete stock of replacement parts and servicing will be provided for the entire Dominion. Canadian Vickers has also completed arrangements to manufacture Buffalo-Manitowoc material-handling buckets.

Imports of British Coal.

Imports of British anthracite coal received during the month of July through the port of Montreal totalled 182,326 tons, an increase of 72,000 tons over the same period last year. From the beginning of the navigation season in April to the end of July the imports of the British product amounted to 529,753 tons, an increase of 128,947 tons over the corresponding period of 1931.

The St. Lawrence and Other Power Projects.

The Queenston plant of the Hydro Electric Power Commission of Ontario, on the Niagara River, with 533,000 horse-power installed, is still the largest completed hydro-electric plant in the world, but, as will be seen from the following, will not long continue to be so.

The total power capacity of the St. Lawrence River is now quite definitely established, as, in round figures, 5,000,000 horse-power. Of this, commencing at the upper end, 600,000 is available at Cryaler Island and 1,400,000 at Barnhart Island, or a total of 2,000,000 in the international section; 2,000,000 horse-power can be made available in the Soulanges, or Beauharnois section, and 1,000,000 in the Lachine section, or a total of 3,000,000 horse-power in the Quebec section; the total amount of the work so far done or authorised in regard to these major or master developments is 500,000 horse-power in the Soulanges or Beauharnois section. The St. Lawrence, therefore, possesses a total of 5,000,000 horse-power in four sites, of which 500,000 horse-power is under development at the Beauharnois site, and has a possible ultimate capacity in a single plant of 2,000,000 horse-power.

Investigations carried out by the province of British Columbia during several years and recently completed show some remarkable possibilities. The waters of the Chiko Lake district can be brought through the coast range by a tunnel 9½ miles long, and 1,430,000 horse-power can be developed therefrom in a single plant under a head of 3000ft.; the Skeena and Nechako rivers can be similarly utilised to develop 800,000 horse-power under 2000ft. head. The British Columbia Electric Power Corporation has similar work under construction at Bridge River, where two 2½-mile tunnels will convey water to develop 600,000 horse-power at 1200ft. head.

On the Saguenay River, Quebec, the Chute-a-Caron plant, with 260,000 horse-power, is completed, and 800,000 horse-power is under development at Shipshaw, which will give over 1,000,000 horse-power in two plants on this river.

The foregoing covers only a few of the largest existing or proposed developments. Other rivers in desirable situations have comparable, or even greater, capacity than the St. Lawrence, but in respect to the largest single plant there is nothing yet in sight within or outside the Empire that will equal the Beauharnois development if it is completed to its full capacity. The practice for a number of years has been to make exhaustive studies for the purpose of obtaining the maximum beneficial use of each river as a whole rather than to develop the most obvious site—the breadth of conception of what is possible is ever widening and the concentrations of power are becoming ever greater. It is, therefore, quite probable that something more than 2,000,000 horse-power in a single site will be accomplished in the not distant future.

Improvement in Construction.

Improvement in the construction industries has been one of the bright spots in the usual mid-summer period of industrial activity in Canada this year. For the first eight months of the year contracts awarded have nearly reached the 100,000,000 dollar mark, made up of 39·7 per cent. engineering work, 33 per cent. business buildings, 20·7 per cent. residential buildings, and 6·6 per cent. industrial buildings. For the month of August, the percentage for industrial buildings was nearly three times the eight-month average.

The Rubber Industry.

The rubber industry in Canada is rapidly coming to the front in importance. During 1930, Canada was the fifth largest importer of raw rubber, coming after the United States, the United Kingdom, France, and Germany. A capital investment of 69,164,512 dollars is involved in the industry. Production in the industry last year was valued at 73,752,673 dollars.

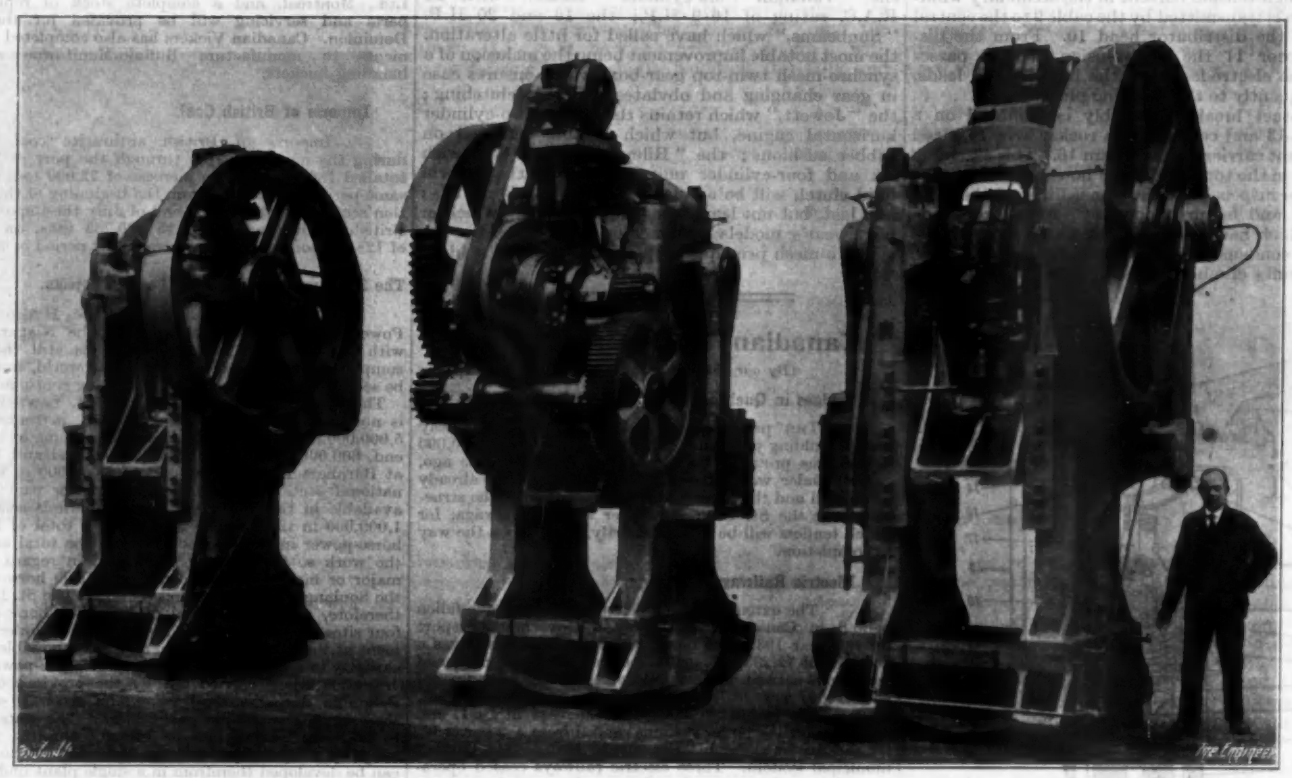
Beauharnois Delivers First Power.

THE gigantic Beauharnois power development, harnessing the St. Lawrence River between Lake St. Francis and Lake St. Louis, began to feed electric power to the district of Montreal on the scheduled date of delivery, October 1st. This marked completion of the first stage in the 500,000 horse-power hydro-electric undertaking. Actually the initial capacity consists of four 50,000 H.P. units, together with two small service units, but the power-house has been so designed that the additional units can be readily added to bring the big power plant up to its full designed capacity of half a million horse-power. Much work still remains to be done on the power canal, a great cut of over 15 miles in length, to enable it to carry the water necessary for capacity operation. Reaching from Lake St. Francis to the power-house at Beauharnois, on Lake St. Louis, the canal permits the development of hydro-electric power from a head of 82ft., the drop in water level through the rapids, the natural bed of the St. Lawrence between the two lakes.

The first delivery of power from the Beauharnois power station took place to the lines of the Montreal Light, Heat, and Power Consolidated, under an initial contract of 35,000 horse-power, which is to be increased over a

TRIMMING PRESSES FOR STAMPINGS

B. AND S. MASSEY, LTD., MANCHESTER, ENGINEERS



period of years to 150,000 horse-power. Almost immediately the plant will also take up the supply of 25,000 H.P. to the Ontario Hydro-Electric Power Commission, under a contract that is to run eventually to 250,000 H.P. The Commission is taking delivery of power at the eastern boundary of the Province of Ontario, which, like the power from Paugan Falls on the Gatineau River, will be carried to the Leaside station, Toronto, at 220,000 volts pressure, the highest voltage transmission in Canada. The distance is well above 300 miles, and on completion of the hook-up to Toronto, the Beauharnois development will be serving in part the power requirements of the two largest Canadian cities.

Large Reclamation Project.

A large project involving the reclamation of 10,000 acres of rich silt lands on Kootenay Flats, near Creston, British Columbia, has been proposed by the Creston Reclamation Company, Ltd., and has received the approval of the provincial Government. Subject to satisfactory arrangements with the Federal Government, concerning certain Indian lands within the area and to the approval of the International Water Board, the work is expected to be begun this Autumn. The whole project is expected to cost 300,000 dollars, and a term of two years has been set for its completion. The whole cost of the project is being borne by the Creston Reclamation Company, and the company binds itself to dyke the area against high water in the Kootenay River, to install necessary power-houses and pumping equipment, and generally reclaim the area before seeking title to the 8000 acres of flood lands that belong to the province. The Provincial Government then agrees to transfer the title of the land to the company, subject to the area being constituted under provincial dyking laws.

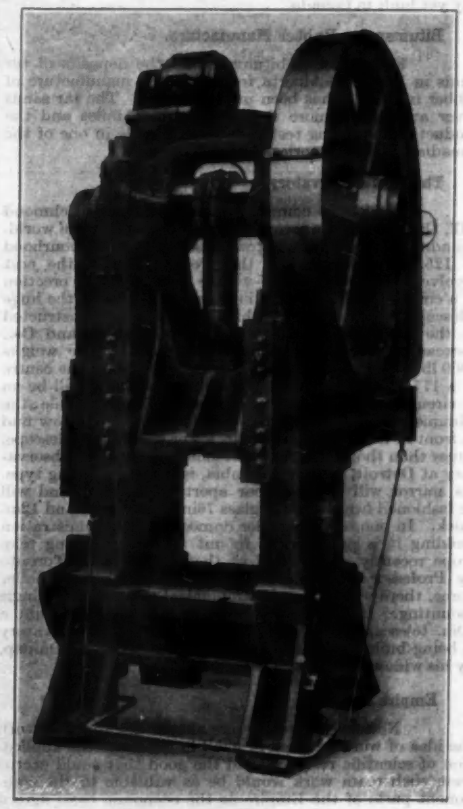
Oil Refinery.

An oil refinery with a capacity of from 100 to 150 barrels daily is to be erected at Weyburn, Saskatchewan, by a local syndicate headed by J. A. McBride, president of the Crown Oil Company, Ltd. An order for the necessary machinery has already been placed, and work on the plant is expected to commence almost immediately.

Presses for Trimming Stampings.

The accompanying illustrations, represent a group of tie-bolt type power presses, with several novel and interesting features, which have recently been built by B. and S. Massey, Ltd., Openshaw, Manchester. The barring device for tool setting, the handle of which is seen on the left-hand side of the nearest machine above, is a standard fitting on Massey presses. It consists of a ratchet and toothed wheel, by means of which the crank may be rotated and the ram thereby raised. While the barring device is in use the clutch has to be locked out of action, a catch actuated by the foot lever ensuring that the barring lever cannot be raised accidentally while the clutch is in operation. The final adjustments in tool setting are made by means of ratchet mechanism on the connecting-rod, the lower portion of which is screwed into the upper portion and is fitted with a toothed wheel instead of the usual hexagon and spanner. The right-hand machine in the group illustrated above shows this toothed wheel, and the pinion, which engages with it, as well as the ratchet bar which actuates the pinion.

The two presses seen on the left-hand side of the illustration are fitted with a friction clutch which obviates the necessity of the barring device described above. By means of this clutch the ram can be raised or lowered as required, the final adjustments being made as in the press previously referred to by the ratchet mechanism on the connecting-rod. The friction clutch is shown on the high-speed shaft of the middle machine. This clutch is actuated by a hand lever and a brake is provided to work in conjunction with it, so that as soon as the clutch is released



SMALL TRIMMING PRESS

the brake comes into action and instantly stops the movement of the ram.

The machine on the right-hand side is fitted with a jaw clutch, which is actuated by a foot lever, a spring throwing the clutch into engagement when the lever is depressed. It will be observed that the whole of the clutch mechanism is outside of the gear wheel, and can be dismantled without disturbing any other parts. Each of the clutch members is fitted with inserted hardened steel driving faces. Smaller presses are fitted with Massey's foot-operated clutches of the part-rotating key pattern, which are likewise situated outside the gear wheel for convenience of inspection and renewal, as clearly seen in the press illustrated separately.

In all sizes of press the ram is guided in V-slides, which can be adjusted to take up wear and, in addition to the main ram, there is a separate excentric connecting-rod and slide outside the ram, which can be used for cutting-off, &c. The presses are all driven by electric motors, which are mounted, as shown, on a hinged platform, with a supporting screw for adjusting the tension in the belt. They are all geared, single-reduction gearing being employed in the smaller sizes and double-reduction gearing for the larger machines. The gear wheels are of steel and machine cut. For lubrication the one-shot system is used throughout, the oil container and pedal, together with the pipes which convey the lubricant to the different points, being seen in the illustrations.

The machines are heavily and strongly built, the separate portions of the cast iron framework being held together by steel tie-bolts of large diameter. The crank shaft can be removed without disturbing the crown block. The presses are made to give effective pressures from 60 to 380 tons, and provide an alternative to the makers' upright solid frame presses, which are usually direct driven.

Steam Pipe Work.*

By J. ARTHUR AITON.

Pipe work must be approached from three angles: first, the raw material, which is the tube, the material from which the tube must be made, and the method of manufacture of the tube as it affects the pipe; then the pipe and its method of manufacture; and then the arrangement of the piping. These, of course, cannot be considered apart from each other, for one thing dominates them all, and that is the temperature of the steam; as it rises the expansion of the pipes rises and the strength of the pipes falls, necessitating increase in thickness, consequently in stiffness; thus the pipes are less able to take up the movements due to expansion, although these have been increased in magnitude. So far mild steel, 0·15/0·19 carbon, 24/29 tons, is the only material from which high-pressure and high-temperature pipes have been made in this country, and owing to the action of this material under high temperature, pipes have already become excessively thick. Of late years with the advent of these high temperatures, engineers have been forced to take serious notice of creep in steel. Not very much is known of it, even the metallurgist, although in close touch with the phenomenon, has not yet had time to ascertain how it acts throughout long periods of time, but knowledge is growing rapidly. Even so, it is no matter for surprise that this question has brought some bewilderment to the engineer, and he has been forced to be very conservative in his treatment of it.

Creep is the term which has been applied to the slow and continuous stretch which takes place in steel under a steady load; at atmospheric temperature this is either absent or so slow as to be negligible, but as temperature is raised creep becomes a serious subject.

Stress, temperature and time form the equation which determines the amount of creep; as one or other of these three varies, one or both of the others must also vary. To the engineer, permissible stress is the unknown; he can state the quantity of creep allowable, the time during which it will take place, and the temperature under which it shall take place, but he must refer to the metallurgist

* From a lecture to the London Local Group of the Electrical Power Engineers' Association, October, 1932.

for the permissible stress. If the maximum life of piping be taken at twenty years, 175,200 hours, it will be safe to compute the maximum time during these twenty years that the piping will be under full temperature and pressure to be 100,000 hours.

The allowable amount of thinning due to stretch in 100,000 hours may be taken at 1 per cent., which, in the language of the metallurgist, is one-tenth of one-millionth of an inch per inch per hour, or, in the language of the machine shop, about one-thousandth per inch per average year.

Temperature is fixed by the design of the station and may be taken at the maximum, 900 deg. Fah.

The question then to be put to the metallurgist is, what stress will produce a creep of one-tenth of one-millionth of an inch per inch per hour at 900 deg. Fah., and on his answer depends the design of the piping.

These calculations are based on the assumption that the rate of creep is constant from the commencement and for all time; this is not correct, for it is known that during the first few hours the rate of creep is comparatively rapid, but that it settles down to a fairly regular rate, which, however, decreases slowly at first and more rapidly as the years go on. It is this decrease of the rate of creep in the efflux of time which is not yet determined, but as it is all favourable it may be neglected at present.

In the light of available data to-day the metallurgist informs us that at 900 deg. Fah. the stress to produce conditions specified is 3 tons, but at 1000 deg. Fah. the stress falls to 1½ tons in 0·17 carbon steel, which means that this material is not suitable for temperatures over 900 deg. Fah. For 0·17 carbon steel working to 60 per cent. of the stress to produce the creep rate specified the following are suitable maximum working stresses:—900 deg., 4500 lb.; 850 deg., 5500 lb.; 800 deg., 6500 lb.; 750 deg., 7500 lb.; 700 deg., 8500 lb.

These stresses are below the stresses which will produce a creep rate of one-hundredth of a millionth of an inch per inch per hour, or one-tenth of 1 per cent. during the life of the pipe.

Having fixed the limit working stresses, their effects on practice can now be considered. Assuming two stations, the one working at 1200 lb. pressure, 700 deg., and the other at 750 lb., 900 deg. In the first, with a working stress of 8500 lb., a 10in. bore pipe would be ¾in. thick, and in the second, with a working stress of 4500 lb., a similar pipe would be ¼in. thick. If, however, in the first instance, that is at 1200-lb. pressure, the temperature is gradually raised, the thickness would be at 750 deg., ⅝in.; 800 deg., ⅞in.; 850 deg., 1⅛in.; 900 deg., 1⅜in. Excessively thick tubes present so many difficulties in manufacture that it would not be easy to work at 750 deg. with this pressure, and would not be practical to work at any higher temperature; in other words, we have reached a limit beyond which we cannot go with mild steel, 0·15/0·19 carbon, 0·6 manganese, 0·04 silicon, 0·04 phosphorus.

If temperature is not to remain low at high pressure, or pressure to remain low at high temperature, an alloy steel must be found which will give better results under high temperature conditions; there are many alloy steels already on the market which do this, but they require special heat treatment. Steel for pipe manufacture has to be capable of being worked at high temperatures in the manufacturing processes without requiring elaborate heat treatment afterwards. Alloy steel stud bolts are regularly used, they have no head formed on them, but are provided with a nut at each end in order that the material shall not be worked under heat after leaving the steel makers' works.

But specifying the thickness of the pipes does not mean that you will get that thickness. The maker of solid-drawn hot-finish tube requires a tolerance of 12½ per cent. up or down, which means that the pipe must be specified 12½ per cent. thicker than the minimum thickness required, and may come out 12½ per cent. thicker than that specification. This means that a pipe required to be not less than ¾in. thick must be ordered 1in. thick, and must be accepted if it comes 1⅛in. thick. This increase of thickness does not affect the strength of the pipe, for as the stress in the metal due to expansion goes up the stress due to internal pressure comes down, but it does increase the thrust on the fixed points to which the pipes connect, and may be serious to them.

A custom is growing up of specifying that pipes shall be made to the actual bore with small tolerances. This tends to thicken the pipe wall still further as these pipes are made to the outside diameter. Take the case of 10in. pipe, ¾in. thick, being ordered 1in. thick. The outside diameter may be 12⅛in., the nearest standard is 12½in. If the actual 10in. bore must be produced, the pipe must be made 1½in. thick to conform to the bore, or nearly double the necessary thickness, whereas if the exact bore had not to be maintained the pipe can be made to the specified thickness and the bore would vary between 10⅛in. and 10½in. If the bore must be maintained, the question of making these pipes from cold finish tubes must be considered, as these tubes are made on a mandrel to actual bore and the only tolerance required in thickness is 10 per cent. up.

Cold-finish tube is much more expensive than hot finish, but when all the circumstances are considered, and if the makers of cold-drawn tubes will realise their opportunity and grasp it by bringing their prices down, it may well prove to be the cheaper in the end.

With thick pipes the question of bending requires serious consideration. With a 10in. pipe ¾in. thick and a radius of 40in., four times the bore, which was a standard a short while ago, the neutral axis of the bend is normally at the centre line of the pipe, the outside wall increases in length by 10 per cent., and the inside wall decreases by the same amount, that is, the outer wall will thin 10 per cent. and the inner wall will thicken 10 per cent. This thinning was not serious in the days when the pipes were worked well within the maximum permissible stress, and further, it did not always take place, as with careful bending the neutral axis could be shifted out past the centre line of the pipe and nearer the outer wall, so reducing the thinning to a negligible amount, but as the pipe is thickened it becomes very difficult, if not impossible, to thicken up the inner wall in bending, and consequently the neutral axis can no longer be at the centre of the pipe; it moves in towards the inner wall of the bend, thus increasing the lengthening of the outer wall and proportionately increasing the thinning until, with the 10in. pipe ¾in. thick, 40in. radius, the neutral axis is actually in the inner wall of the pipe; in other words, the inner wall of the bend does not decrease in length nor increase in thickness, but the outer wall has to increase the total variation in length and decreases in thickness by 30 per cent., which means that that pipe cannot be bent to so small a radius. It is an easy calculation to show that this pipe must be bent to a minimum radius of eleven times the bore in order that the outer wall shall not be thinned more than 10 per cent.

From this it follows that a bend made in the ordinary way from 10in. pipe ¾in. thick must have a radius of not less than 10ft. Now from the point of view of passing steam such a large radius bend is quite satisfactory, and if there is sufficient space to accommodate it nothing can be said against it. But in all power stations the pipe bends serve the dual purpose of passing the steam and providing some of the flexibility necessary to allow the movements due to variations in temperature to take place without damage to the pipes or to the fittings to which they connect. From this point of view the larger radius bend is at great disadvantage, and is in fact out of court; it is an axiom that the larger the radius of the bend the lower will be the flexibility of the pipe line into which it is incorporated, and it is for this reason that some other method of bending has had to be found by which the shortening of the inner wall of the bend can be provided for without the necessity of increasing its thickness, thereby moving the neutral axis back to the centre line of the bend, or even beyond that nearer to the outer wall. A method of bending is now in use which attains the desired object and takes up the excess length in the inner wall by increasing the length of this wall, thus obviating the necessity of increasing its thickness. This extension of the length of the inner wall is obtained by raising a series of creases on this wall which extend circumferentially and vanish out at about two-thirds of the circumference of the pipe. These bends are known as creased bends; they are more flexible than bends of plain pipe made to the same radius, but we do not take this into account in our calculations; their principal value is that they enable a bend to be made in thick pipe to a much smaller radius than can be made in plain pipe without damage. In comparing plain bends with creased and other special bends, the mistake is made of comparing the smallest radius creased bend with an imaginary plain bend of the same radius, such a bend only exists in fancy and cannot be made, although these purely theoretical results are used in criticising the special bends to their detriment. A small radius creased bend should be compared with the smallest radius bend that can be made from plain pipe.

Furthermore, creasing enables a bend to be made in larger bore lap-welded pipe, which bend could not be made by any ordinary method in plain pipe, but pieces would have to be cut out and the pipe welded up. These pipes are used for reheating steam at intermediate pressures from 100 lb. to 150 lb., and the steam is reheated to 800 deg. The pipes have been made up to 30in. bore, ¾in. thick, but could be made up to 40in. bore, ½in. thick. There is a third method of making bends, by raising a series of parallel corrugations round the pipe in the straight and then bending it; in this process the neutral axis remains at or near the centre of the pipe. The variation in the length of the outer and of the inner wall is taken up in the corrugations, those on the outer wall straightening out somewhat, and those on the inner wall closing up. These corrugated bends can be made to a much smaller radius even than creased bends, but their chief advantage is that they in themselves are very much more flexible than either plain or creased bends, and straight pipes can be made to help the flexibility very much by being corrugated at their ends for some distance.

Considerable care has to be taken in the manufacture of creased and of corrugated pipes; first of all, the tubes must be of good quality and well made, as surface defects are intensified and brought into view, and laminations or other hidden defects betray themselves; any variations in the thickness of the wall either circumferentially or longitudinally are shown in the creases and in the corrugations, and if they exceed quite moderate dimensions they render these processes impossible. But even the best pipes may be damaged in creasing and in corrugating by the wrong form of crease or corrugation, which must vary according to the conditions which the pipe is to meet, the thickness of the pipe, and the radius of the bend; they can be damaged by bad heating—excessive heating may burn the outside of the pipe and incorrect heating will produce many small cracks on the inside of the corrugation, any one of which may develop into a fracture under the stress of working conditions. Incorrect design and careless treatment in bending may produce collapsed creases or corrugations or corrugations of varying pitch and varying heights. All these defects in their advanced stages can be detected by any inspector, but it needs care and experience to detect them in their early stages, and they must be detected in their early stages, otherwise they may go into working and develop into fractures. Special apparatus for internal inspection is needed if the tops of the corrugations are to be examined; it is in the tops of the corrugations that these defects are to be found.

All creased and corrugated bends must be annealed, and plain bends ought to be.

British Standards Institution.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

OVERHEAD TRAVELLING CRANES.

No. 466—1932. This specification, which forms one of a series of specifications issued by the British Standards Institution for cranes and derricks, provides for cranes, power-driven in all motions, of spans up to 80ft., and with a load capacity up to 70 tons, suitable for normal service. In general, a factor of safety of 5 has been adopted, but higher factors of safety are recommended with proportionately lower working stresses, for cranes intended for duty of great severity. No attempt has been made to deal with cranes from the dimensional or size standpoint, although in other respects the specification is drawn on very comprehensive lines. Complete formulæ based on the well-known and widely used Bridge Specification have been included in the structural clauses for the calculation of maximum permissible working stresses in the crane structure, while such details as gearing, bearings, brakes, ropes, pulleys and drums are each dealt with fully in other clauses.

At the same time the question of the driving unit has not been neglected, and separate sections are devoted to motors, controllers, cables and protective gear. Care has been taken, however, to exclude anything which might interfere with the freedom of the engineer and the maker in the design of the crane, the object of the specification being to secure the general observance of such fundamental principles as appear desirable to ensure reliability and safety without handicapping the maker or the user in the selection of the most appropriate design for the purpose in view.

STEEL RAILWAY WHEELS AND WHEEL CENTRES.

No. 468—1932. The policy which has been adopted in a number of the specifications relating to railway rolling stock materials has been followed in that duplicate specifications are provided for solid rolled wheels. One of these specifies a chemical analysis and covers wheels for carriages and wagons. In the other, however, no chemical analysis is specified, and it is restricted to wagon wheels only. A specification for Rolled Disc Centres for Carriages and Wagons is also included.

The specifications have been drafted along parallel lines with the corresponding B.S. Specification for Railway Tires, *i.e.*, requirements are included governing quality of material, manufacture, workmanship and mechanical testing. One of the most difficult points that emerged in the preparation was that of arriving at suitable tolerances on the thickness of the web of the wheels. Whilst appreciating the difficulties with which the manufacturer is faced in rolling the somewhat complex outline of a combined solid tire and wheel, the railway engineers were faced with the necessity of ensuring that each wheel should, as far as practicable, be of uniform weight. With increasing speeds, the elimination, or, wherever possible, the reduction to a minimum of all out-of-balance forces, becomes of primary importance.

The clause in the specification dealing with this point has attempted to meet the engineer and, at the same time, represents consistent and good manufacturing practice.

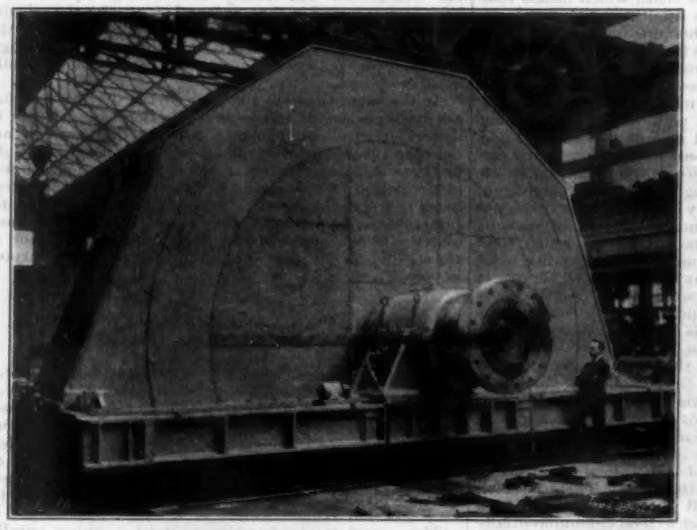
VIBRATING CONCRETE.

THE tamping or consolidating of concrete in the moulds or forms by agitation created by mechanical vibrators, instead of the usual tamping, spading, ramming, and rodding by hand, is a comparatively new method which has come into extensive use by reason of its efficiency and rapidity. Both electric and pneumatic vibrators are in use. The vibration is applied in two ways. For concrete in large masses, as in dams, breakwaters, foundations, and retaining walls, the vibrator is mounted on a wooden base which is placed directly on the concrete, to which it imparts the vibration. Or it may operate a short spud or rammer that is thrust into the concrete. For smaller work, as in columns and their walls, the vibrator is applied to the exterior of the forms. In either case the machine is moved about over the surface so that the vibratory motion extends completely through all parts of the concrete. This method is considered to permit the use of drier concrete than could be placed successfully by hand tamping, to enable the water content to be reduced while increasing the strength and water-tightness of the concrete, to require less cement when the water content may not be reduced, to ensure against voids or hollows around the steel reinforcing bars or steel members covered by the concrete, and also to give a smooth and dense surface by the elimination of minor voids and minute air pockets. It also increases the density, making the concrete practically waterproof, while by reason of the lower moisture content the concrete requires less time for curing. The electric vibrators, operated by induction motors of ¼ H.P., using 110 or 220-volt current, run at a speed of 3500 to 3600 revolutions per minute. There is only one moving part, that being the rotor, which is made out of balance in order to set up the vibratory action when operated at high speed. Where no source of electric supply is available, petrol-electric generating units are installed, mounted on wheels or on a bed-plate.

THE Railway Returns for 1931 show that on December 31st last British railways had 682,759 wagons, a decrease, compared with 1930, of 7457. Their carrying capacity was 7,594,513 tons, a decrease of 50,044 tons, but the average per vehicle rose from 11·30 to 11·35 tons. The total number of wagons, exclusive of special vehicles, of 20 tons and over was 28,915, of which 26,867 were solely for mineral traffic; the corresponding figures for 1930 were 29,018 and 27,038 respectively. The companies also owned 2354 open, 3924 covered, and 12 "roll-off" containers. This total of 6290 compared with 4385 in 1930. There were 502 wagons specially allocated to container traffic. Of the 1905 additional containers provided in 1931, capital account paid for 1448. Before giving the figures as to privately owned wagons, we would observe that no record is available as to their number. The only information under that head is the total registered at the Railway Clearing House. The number so dealt with in 1931 was 1287, which figure compared with 4774 in 1930 and 3884 in 1929. The total of 1287 included 78 20-ton coal wagons, eight 20-ton miscellaneous wagons, 16 20-ton tank wagons, and 1108 12-ton coal wagons.

LARGE SYNCHRONOUS MOTOR FOR INDIA

BRITISH THOMSON-HOUSTON COMPANY, LTD., RUGBY, ENGINEERS



Large Synchronous Motor for Driving a Rolling Mill.

What British electrical manufacturers can do in the way of speeding up operations when necessary is well exemplified by an order received on August 19th by the British Thomson-Houston Company for the construction of the large synchronous motor shown in the accompanying illustrations, together with automatic gear for the main drive of a steel rolling mill in India. The order was received through Associated Electrical Industries (India), Ltd., from the Tata Iron and Steel Company, and on Saturday, October 22nd, the whole of the equipment was despatched from the B.T.H. Company's Rugby works. Originally the continuous Morgan mill, which this new motor will drive, was operated by a 4000 H.P., 375 r.p.m. induction motor with a gear reduction unit, but alterations have been made to the mill to enable it to roll larger stock and greater tonnage, and a more powerful driving motor has consequently become necessary.

In view of the advantages of the synchronous motor, the consulting engineers, the Perin Engineering Company, of New York, decided to call for a machine of that type. Quick delivery being essential, work was begun in the B.T.H. shops within twenty-four hours after the order had been received, and on October 8th, or seven weeks later, the complete machine had passed its final tests. The machine is said to be the first large synchronous motor built in this country for driving a rolling mill, and is believed to be the largest motor of its kind. As will be gathered from the left-hand illustration, it is totally enclosed. A closed circuit air cooling system is consequently employed, and the cooling equipment consists of two electrically driven fans which draw air from openings in the stator frame and deliver it through two water-cooled air coolers.

The motor is rated at 7500 horse-power, 6300/3150 volts, 50 cycles, 0·8 leading power factor, 93·8 r.p.m., and is able to take peak loads of 18,750 horse-power. At full-load rating the temperature rise will not exceed 30 deg. Cent. above an ambient temperature of 55 deg. Cent. With full voltage applied the starting torque is guaranteed not to be less than 108 per cent. of full-load torque, while the pull-out torque is not less than 2½ times full-load torque, and the pull-in torque not less than half of full-load torque. Twice full load may be applied to the machine for five minutes without injurious heating. At full load and at 0·8 leading power factor the guaranteed full-load efficiency was 96·6 per cent., but on test the figure actually obtained was 96·62 per cent. The outside diameter of the stator frame is 26ft. and the length of the complete machine over the coupling is 22ft. 10in. The complete stator weighs 53 tons, while including the shaft and coupling, representing a weight of 21 tons, the total weight of the rotor is 68 tons. Including the base-plate and pedestals the total weight of the complete machine is 160 tons.

Advantages of Synchronous Motors.

Hitherto it has been customary to employ slip-ring induction motors for driving large constant-speed mills either directly or through a gear reduction unit. For mills with a fly-wheel an induction motor is essential, but on mills without a fly-wheel it has become general practice in America to employ synchronous motors, which offer several advantages in the case of a constant-speed rolling mill drive. Unity or leading power factor can be obtained on slow-speed machines, thus enabling a direct drive to be applied to the mill without a gear reduction unit, while at the same time obtaining any desired power factor. Relatively expensive phase-advancing equipment as would be needed with an induction motor is unnecessary. The air gap on a synchronous motor is at least twice and possibly three or four times greater than that on an induction motor. The efficiency of the synchronous motor is higher than that of the induction motor, and the rotor construction in the case of the former is also more simple.

Although the starting characteristics of the synchronous motor are inferior to those of the induction motor, experience in America shows that the former type of machine has no difficulty in starting the mills to which it is applied. The only limiting factor is the peak load, which can be carried by the system from which the motor is fed By means of special starting schemes the peak load can be reduced to a minimum, but synchronous motors must not be applied to mills without consideration being given to the effect on the supply system. The motor illustrated will be supplied from the Tata Iron and Steel Company's own extensive power system and no serious starting disturbance is expected, especially as a starting control scheme designed to give a minimum load on the line has been adopted.

Fabricated Construction.

Needless to say, in accordance with modern practice for medium and large electrical machines, the motor is fabricated, the only castings being the pedestals and bearing liners. Apart from giving a light and stiff structure, fabrication eliminates the time involved in making patterns and castings, a matter of no small importance in the case of the machine under consideration. The stator frame of the motor is of box section fabricated from heavy steel plates and cross bars, the various members being welded together to form an extremely rigid structure. To prevent condensation of moisture on the stator core and windings during idle periods, heating units are provided in the stator frame. The stator core consists of segmental soft steel laminations of high silicon content and having low hysteresis and eddy current losses. After punching the laminations were specially treated in order to prevent circulating currents between the sheets. Through the core there are many ventilating ducts which communicate with the back of the frame to allow unrestricted air circulation for cooling purposes. By means of double dovetailed folding keys the laminations are held in the stator frame. For holding the laminations axially through-bolts are provided between a large number of steel segmental flanges with heavy fingers welded on. Clamping bolts outside the active region of the core ensure rigid clamping of the punchings.

Windings.

The stator winding is a two-layer open-slot winding with two coils per slot. The coils are former wound and all the turns are arranged in a single tier in order to maintain a low voltage between adjacent conductors. To reduce eddy current losses each turn is subdivided. The individual conductors are composed of rectangular asbestos-covered copper wires and each turn is insulated with mica tape. The slot portion of the coils is insulated with mica-folium ironed on by the Haefely process and pressed to the shape and size of the slots. The end windings are insulated with a flexible insulation consisting chiefly of mica tape with a final protective layer of varnished dynamo tape. In the slot portions, the coils are protected from mechanical injury by means of varnished horn fibre slot liners and treated wedges are driven in over the coils. The end windings are supported by being securely lashed to insulated steel rings held by brackets from the stator frame. Sheet iron covers assembled on a channel framework in sections enclose the ends of the stator, the arrangement being such that by removing these steel covers the motor can be converted from a totally enclosed to an open type machine.

In order to take care of occasional accidental thrusts arising from the failure of the breaking spindle which connects the motor to the mill, a thrust bearing is incorporated in the driving end pedestal. The bearing consists of Michell thrust pads mounted on a semi-circular ring and secured to the bottom half of the pedestal inside the housing. A ring forged integral with the shaft forms the thrust collar.

Sheet steel laminations hydraulically riveted together and steel end plates form the rotor poles, which are secured to the spider by bolts. The rotor windings consist of rectangular copper strip wound on edge with mica insulation between turns. The coils are insulated from the poles with mica reinforced with varnished horn fibre, and are securely supported in position between moulded insulation flanges. Squirrel-cage windings are embodied in holes in the pole faces, and are short circuited by means of brass segments to which they are silver soldered.

Rotor.

The fabricated steel rotor spider consists of a steel rim and centre discs, which are connected by means of fitting bolts to the corresponding flanges forged on the shaft, the joint between the two parts of the spider being made by means of dumb-bell tapered keys extending the full width of the rim. The two parts of the centre discs of the spider are joined by plates having a large number of fitting bolts. After forging and before machining the mild carbon steel shaft was thoroughly and uniformly annealed, and after it had been machined to rough dimensions, it was uniformly reheated to a temperature just below the "carbon charge" point and allowed to cool freely. A hole was trepanned through the centre of the shaft throughout its full length so as to expose any internal flaws. A half-coupling to connect to the coupling on the mill shaft has been shrunk and keyed on to the shaft extension of the motor. The collector rings are mounted on a sleeve insulated by means of a mica bush. The main terminals consist of insulated copper bars brought to an opening at the bottom of the stator frame and held in position by means of aluminium clamped plates. By means of links it is possible to change the stator connections for 6300 or 3150 volts. The fabricated steel base plate is made up of heavy girders, and provision is made for racking the stator frame aside in order to expose the rotor poles and the inside of the stator core. Hydraulic jacks are also provided for racking the stator along the base plate.

Control Equipment.

By means of the control equipment the mill can be started, stopped, and reversed from a control pedestal mounted in a convenient position near the mill and carrying a master controller, a push-button, and three indicating lamps. By moving the master controller the motor may be started in either direction, stopped or "plugged" in the event of a quick stop being necessary. The master controller has a single-point control in each direction, and merely initiates the starting operation, which is carried out completely automatically by means of an automatic control panel working in conjunction with solenoid-operated circuit breakers in the motor stator circuit. When pressed the button on the control pedestal causes the motor to give a specially high starting torque to meet exceptional circumstances. The motor is started by solenoid-operated circuit breakers working in conjunction with an auto-transformer and reactor in the stator circuit. A motor-operated controller controls the sequence of the circuit breaker closing and the intervals between the operation of successive breakers. The motor is brought up to 95 per cent. synchronous speed on reduced voltage obtained from taps on the auto-transformer. At this speed a centrifugal switch on the motor closes and causes the machine to be switched on to a reactor and at the same time causes the motor field current to be applied. When the motor has pulled into synchronism as the result of the building up of the field, the reactor is short circuited, and finally, the field is adjusted to the correct running value, all these operations being performed automatically. Although the equipment is designed to start the motor under normal conditions with a minimum line disturbance, if required it is possible to obtain a higher torque with higher line current.

Automatic protection is provided against overload, under-voltage, earth leakage, failure of ventilating fan motors, overheating of bearings, and a weak field. An alarm is sounded in the event of excess temperature of the cooling air, and the equipment is locked out if the starting sequence is not completed in a reasonable time. Although the field current for this synchronous motor is normally supplied by a separately driven exciter, by means of change-over switches it can be drawn from a 250-volt D.C. plant. The exciter set consists of four machines—(1) a 110 H.P., three-phase, 50-cycle, 440-volt, 970 r.p.m. squirrel-cage induction motor; (2) a 60 kW, 250-volt main exciter; (3) a 15 kW, 250-volt master exciter, and (4) a 2 kW, 110-volt battery-charging generator. The main exciter supplies the synchronous motor field alone, and can therefore be varied by a small rheostat in the exciter field. The master exciter is a constant-voltage machine, which serves to supply exciting current for the other exciter, and to provide power for operating control devices and for closing circuit breakers. The battery-charging generator "floats" on the circuit breaker tripping battery, and maintains a constant trickle charge.

During August 36 per cent. of the new cars sold in South Africa were of British manufacture. In July the British percentage was about 32.

Engineers' German Circle.

THE second session of the Engineers' German Circle opened on Monday, October 10th, at the Institution of Mechanical Engineers, when a lecture was given by Dipl.-Ing. F. Ohlmüller, chief engineer of the Siemens Schuckertwerke, Berlin, on "Der Benson Hochdruck-kessel (225 at.) als Land und Schiffskessel-Ausführungen und Erfahrungen." On Thursday last, October 20th, by invitation of the Hamburg-America Line, the members of the Circle, along with representatives of the Admiralty, the Board of Trade, Lloyd's Register of Shipping, and other interested parties, visited the cargo liner "Uckermark," on her arrival from the Dutch East Indies at Gravesend, and inspected for themselves the Benson boiler.

Dealing first with Herr Ohlmüller's lecture, it may be stated that it was a full and valuable account of the pioneer work on the Benson critical pressure boiler, which has been carried out by Siemens Schuckert since the early experimental work done at the English Electric Company's works at Rugby more than nine years ago. After describing the principle of the Benson system of steam generation, in which water passes from liquid to gas form at the critical pressure of about 3200 lb. per square inch, and at about 707 deg. Fah., the author went on to describe the test boiler of 10 tons per hour capacity built at the Nonnendam power station, Berlin-Siemensstadt. The No. 1 and No. 2 Benson boilers, of 25 and 40 tons per hour respectively, at the firm's Gartenfeld works, were then described, after which an account was given of the large 100 to 120 tons per hour Benson boiler at the Langerbrugge power station in Belgium. This part of the lecture was specially interesting, as it dealt with the difficulties which had been experienced in the early working of the plant and the means which have been adopted to overcome them. Before passing to the marine applications of the Benson boiler, a typical design for a stoker-fired boiler was illustrated.

The marine section of the paper, which described the 6000 S.H.P. high-pressure Benson boiler and turbine installation on the s.s. "Uckermark," included details of the valves and steam pipe connections, and the experiments made which have shown the successful operation of the plant with salt water injection. Further interest was added to Thursday's visit by the fact that Dr.-Ing. E. Goos, the superintendent engineer of the Hamburg-American Line, and Herr Küntzel, chief engineer of Blohm and Voss, came over specially to demonstrate and describe the plant, which they did in excellent English, although naturally many members of the Circle asked supplementary questions which lead to further conversations in German. A description of the "Uckermark" installation was published by Dr.-Ing. E. Goos in our contemporary the *Shipbuilding and Shipping Record* of November 26th last, and a translation of Herr Ohlmüller's lecture will appear, we understand, in an early issue of the *Steam Engineer*.

The "Uckermark" has now been on service for about two years, and apart from some early troubles, the Benson boiler has, we were informed, functioned very satisfactorily. Its working pressure is about 3200 lb. per square inch, and temperature of the steam is 707 deg. to 752 deg. Fah. At this critical pressure and temperature the steam exists only as a gas, and contains no molecules or drops of water. The importance of absolute steam-tightness will therefore be apparent. In length the Benson boiler takes up rather less space than the double-ended Scotch boiler alongside it, but its height is rather greater, being about 20ft.

The boiler is oil fired from both ends, and, as originally arranged, there were five furnace fronts or burners at each end, vertically one above the other. After the first voyage, in order to ensure more satisfactory combustion and a more even distribution of the stresses on the tubes, the burners were rearranged, and only four in each end are now used. Alterations in the groups of tubes were also made, as it was found that the original arrangement with the critical point of the water in the first radiating stage led to overheating and bursting of the tubes in which the transformation from water into gas took place. These alterations were made in October, 1930, since when no further trouble has been experienced.

In order to accommodate the higher pressure steam, a two-stage high-pressure turbine—each stage in a separate casing—was fitted, driving a separate pinion. Leaving the boiler at 3200 lb. pressure and 752 deg. Fah., the steam is passed through a reducing valve and afterwards through a multi-coil superheater. Entering the special high-pressure turbine, the steam has a pressure of about 882 lb. per square inch.

Using the Benson boiler alone for propulsion purposes, a machinery output of 6200 S.H.P. can be obtained, the corresponding ship speed being 14 knots loaded. With the Benson boiler shut down, and using only the three Scotch boilers, the speed of the ship is 12 knots. Whereas the weight of contained water in the double-ended Scotch boiler is about 35 tons, that in the Benson boiler is only about 1 ton. There is no water level, as such, nor are there any water gauge columns or glasses.

The weight of the Benson boiler alone is about 32 tons, or with all accessories, grids, insulation, furnace fronts, &c., about 100 tons. One of the most interesting of the boiler auxiliaries, and one which greatly interested the visitors, was the high-pressure feed pump. There are two such pumps, each of the ram type, with six single-acting pistons. The suction and delivery valves are placed about 5ft. away from the pump cylinders, so that the intervening column of water oscillates to and fro in synchronism with the displacement of the pump rams. In this way the feed water does not pass through the pump cylinders, but merely through the valves, and the water column may thus be regarded as the piston or ram. Although no material trouble has been experienced with these ram-feed pumps, we were given to understand that Blohm and Voss are meanwhile experimenting with a special type of centrifugal feed pump, which, if successful, will later be installed.

Based upon the actual voyage results during the past two years, the efficiency attained by the Benson boiler averages about 90 per cent., varying from 88·5 per cent. to as high as 92 per cent. This figure compares with an efficiency of about 65 per cent. from the Scotch boilers on board. The further development of the Benson system will be awaited with no little interest.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

CONFIDENCE in the future is manifest in iron and steel and engineering circles in the Midlands and Staffordshire, and the recent growth in the volume of trade being done, though it is admittedly small, encourages industrialists to believe in a more substantial expansion as world conditions improve. In this industrial area much is hoped for as a result of the new trade relations within the Empire, and a certain but gradual increase in business is looked for. It is this week reported that inquiries have been received from various overseas markets which, if they result in orders, will do quite a lot towards stimulating activity at the works in this neighbourhood. Exports have been steadily decreasing of recent months, a fact, no doubt, primarily due to the depression which exists in almost all countries to which our goods are shipped. An increase in overseas demand is of great importance just now, and efforts are beng made to turn all inquiries received into actual transactions. Manufacturers are getting more of the home trade than they were, thanks in part to tariffs, and there are evidences which point to a greater replacement of manufactured goods from home sources as the economic situation mends. Financial stringency is undoubtedly one of the main reasons for the continuance of the hand-to-mouth buying system which has been in vogue for so long. Larger tonnage orders would make a big difference to production costs and to local producers' ability to find regular employment for their hands. It is contemplated that as existing stocks of foreign goods are disposed of and those of British manufacture are reduced, orders for replacement will be made almost entirely from native sources and that traders not having to carry two stocks will place larger orders with district makers. Hardware and hollowware makers are already, to a limited extent, finding this the case, especially where seasonal goods are concerned. Where the iron and steel and other heavy industries are affected, however, there is little if any forward movement in evidence. The brighter prospects and the movement in the lighter trades are cheering, in so far as they suggest that additional material for making up will be required ere long. Indeed, blast-furnacemen have experienced some revival in demand as a result of improved employment in the light castings industry. Unfortunately, the heavy engineering industries still have poor prospects. Until there is a return to a policy of "spending," structural and other engineers and manufacturers engaged upon the production of railway rolling stock, &c., are likely to remain but poorly employed. Practically all the heavy engineering trades in the Midlands and Staffordshire are feeling the pinch of the economic depression, some to a greater degree than others. The movement in the automobile industry is helping to a fair extent to alleviate the general position, producing work, as it does, for a host of minor trades. Buying of iron and steel on Birmingham Exchange this week has been a little better than of late, but the aggregate tonnage is relatively small. Attendances have been thin and the market position has undergone no substantial alteration on the week.

Sheet Makers' Activities.

Galvanised sheet makers are busily engaged consolidating their position, and one announcement follows another until consumers are wondering where it will all end. Hardly had the concerted advance of £1 per ton to the home trade been digested and the statement that quotations would henceforth be for material delivered, instead of f.o.t., been received than a further rise of 5s. per ton, stated to be to cover the cost of carriage throughout the radius of supply, was made. But the price of 24-gauge galvanised corrugated sheets to the home trade is not to be firm at £11 5s., nor are black sheets of the same gauge to be settled at £9 5s., for sheet makers have now evolved a scale of selling prices graduated according to tonnage. Only large buyers are to secure supplies at the prices given above. Smaller users are to pay more. The scale as decided upon by makers is one of 10-ton lots, 4-ton lots, 2-ton lots, and under 2 tons, and this applies alike to galvanised and black sheets. The selling prices as at present fixed are 24-gauge galvanised sheets in 10-ton lots, £11 5s.; 4 tons, £11 10s.; 2 tons, £11 15s.; under 2 tons, £12 15s. The scale for black sheets, 24 gauge, is £9 5s., £9 10s., £9 15s., and £10 15s. for the respective tonnages as given above. These prices should have the effect of stimulating buyers to purchase in larger tonnages, the difference as between 1-ton lots and 10-ton lots being considerable—30s. per ton. At the moment buyers for the home trade appear to be holding off the market, for they are not generally pleased with the attitude makers are taking up. On the export side there has been no change in the selling price, which remains at £10 per ton f.o.b. Liverpool for 24-gauge galvanised corrugated sheets. Business is a little brighter, overseas consumers having recently placed some acceptable orders with local mills. There is also a goodly array of inquiries still in circulation for various overseas markets.

Steel Prospects.

Prospects for steel consumption are a little brighter this week, for, after a prolonged period of unprecedented quietude, one or two constructional engineers report a slight improvement in inquiry. It is not sufficient to affect the general position, but, taken as an augury for the future, it is of some importance. Midland structural yards have been so very quiet that their material requirements have been small indeed. Engineers will welcome additional business, even though practically all contracts to-day have to be secured in open competition and do not permit a large margin of profit. There are no big-scale works on hand, and retrenchment is still being carried out by many local authorities and industrial corporations. Recent appeals for the putting into hand, where possible, of works now being held up on account of trade depression, as apart from financial stringency, will, it is hoped, have some effect. At date demand for all classes of finished steel is quiet, and selling prices are steady at the figures laid down by the Steelmasters' Association. In the half-products branch the position is improving, for Continental materials are becoming dearer. If there were any real consumptive demand local makers would now stand a really good chance of successfully competing for the available business. Practically all classes of foreign steel have advanced in price to such an extent that after carriage to Birmingham has been met, consumers might well be out of pocket by not buying locally. Staffordshire re-rollers faced with the higher cost of their raw material, are asking an additional 5s. per ton for re-rolled bars. As business is none too good, however, they do not appear to be able to command this figure. While re-rolled bars are quoted £6 12s. 6d., business can still be done in the region of £6 7s. 6d. to £6 10s. There is no alteration on the week to quotations of all-British bars, nor to billet prices. Staffordshire steel hoops sell at £9 10s. per ton.

Pig Iron.

There is no change in the pig iron situation on the week. Blast-furnacemen are making a steady output and the greater proportion of it is going into current consumption. The engineering foundries are taking very little more material than they were, but the light foundries are gradually increasing their consumption. The forges are so poorly engaged that there is hardly any sale for this class of material. Smelters still complain of the relative poorness of specifications. Tonnages are extremely light, users being indisposed towards stocking even a few weeks' supplies of material. They have no difficulty in getting early and prompt deliveries, and little or no cause to worry as to prices, consequently they prefer the furnacemen to carry the stocks. Smelters in this area have large accumulations of material, but only in Northamptonshire are they such as to occasion much concern. Selling prices are as fixed by the Central Pig Iron Producers' Association, namely, Derbyshire and North Staffordshire No. 3 foundry, £3 6s., forge £3 1s.; Northamptonshire foundry £3 2s. 6d., forge £2 17s. 6d., all per ton delivered to Black Country stations, and subject to rebate to large consumers.

Finished Iron.

The finished iron industry in Staffordshire is ambling along at something like 50 per cent. of capacity. The past week has witnessed some movement in the strip department, makers having received a fair amount of orders from tube makers. The automobile trade has also been in the market for a moderate volume of special material. Values of wrought iron strip have not changed, quotations varying from £10 7s. 6d. to £10 10s. per ton. Makers of common bars are pleased to see that Belgian No. 3 iron, which competes so successfully for the Black Country nut and bolt and fencing market, has appreciated further. It is this week quoted from £6 2s. 6d. to £6 7s. 6d. per ton delivered. It will have to go even higher, however, before local makers can hope to meet the competition. Their quotation remains at £7 15s. for fencing bars, and £8 for nut and bolt quality iron. Staffordshire marked bars sell steadily in small quantities at £12 per ton at makers' works. Crown bars are quoted £9 upwards, but little business comes into this district, makers from outside taking more than their fair share.

Shrewsbury Water Scheme.

Shrewsbury Town Council on Monday accepted contracts for the carrying out of a new scheme of water supply for the town from the river Severn, the total cost of which is estimated at £105,000. This decision settles a controversy that has raged in the town for half a century as between the merits of a river and an upland scheme.

Mining Education Criticised.

In his presidential address to the South Staffordshire and Warwickshire Institution of Mining Engineers in Birmingham, Professor K. Neville Moss (of the Mines Department, Birmingham University) said that although as an institution they were mainly concerned with the vocational side of education, they should not ignore the immense importance of general education. Technical education in mining had in this country been of a part time or full-time nature. Part-time education had been given by the county mining schools and technical colleges, wherein an attempt had been made to meet the statutory requirements laid down for certificates of competency for managers, under-managers and surveyors of mines. That type of mining school had been of immense value to the mining community, and they in that Institution could justly be proud of the South Staffordshire School, which, under the guidance of one of their Past-presidents, Mr. Charlton, had established itself in the front rank. Taking the country as a whole, however, he feared the industry had suffered much from the narrowness of the training given in schools of that type. For years their curricula had been entirely vocational, and, as in the main, the education given was superimposed upon a very meagre general education, it was no wonder that it produced men lacking in vision and doomed to follow in the static traditions of their forebears.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

More Problems for Engineers.

LANCASHIRE engineers have a very close concern in recent political and economic problems. The Ottawa agreements and the announced intention of the Government to terminate the commercial agreement between this country and Russia, are, of course, closely interwoven, and separately and severally their possible reactions are matters in which engineering firms are taking a keen interest. As to possibilities of increased trade with the Dominions as a consequence of the Ottawa agreements,

Lancashire engineers at the moment are disposed to adopt a somewhat reserved, and, on the whole, not too optimistic an attitude. They are more immediately concerned with the threat to business which, in the absence of the conclusion of a satisfactory new one, arises from the denunciation of the Russian agreement, for the Russian market is regarded here as of far greater immediate importance from an engineering point of view than are the Dominions. Heavy electrical engineers, machine tool makers, locomotive builders, boilermakers, and manufacturers of certain speciality products, such as rubber machinery, are apprehensive of the effects of this latest step on a market in which, through the recent extension of facilities by the Exports Credits Guarantees Department, there has been growing hope of further important orders for the engineering trades. At the present time, these fears of adverse results are uppermost. There is, however, in some quarters a disposition to regard the conclusion of a new trade agreement with Russia as inevitable, and in this the interests of the heavy engineering trades would be a primary consideration.

A Co-ordinating Movement.

An interesting proposal to co-ordinate the management of the gas and electricity supply departments has been made by a special committee of the Salford City Council. This step arises from the apparently conflicting interests of the two departments. The Electricity Committee is anxious to proceed with an extension of its network of low-pressure street mains. On the other hand, the Gas Committee purposes to spend about £90,000 on the installation of new vertical retorts and views with some concern the extension scheme of the electricity department. The special committee has come to the conclusion that it would be wrong to stand in the way of normal progress—that the extension of electricity supplies, principally to small houses, should be proceeded with, and that "the gas department must face a progressive decrease in the use of gas for domestic purposes, especially for lighting." It is recommended that the entire position should be carefully scrutinised before the proposed expenditure on new gas-producing plant is sanctioned by the City Council. To co-ordinate the control of the departments concerned with the supply of light and power and with public lighting, the special committee recommends that a Light, Heat and Power Committee should be set up, whose principal function it would be to consider developments in the light of public economy and public interest.

A New Move in Technical Education.

Co-ordination in another direction is involved in a scheme which is under consideration by the directors of education in Manchester and Salford. This scheme aims at some measure of co-operation between the Manchester College of Technology and the Salford Royal Technical College. In a joint memorandum which the directors of education have prepared, it is proposed that, as a first step, a joint committee composed of members of the staffs of the two colleges should be appointed to formulate the programmes for the 1933–34 session of the institutions concerned. When such a programme has been formulated, it is added, it will show the educational advantages in detail, and, at the same time, indicate any changes that may be necessary regarding the use of equipment and accommodation. It will also make it possible to gauge actual economies and estimate for the future expenditure.

Non-ferrous Metals.

The past week's depreciation in sterling exchange has left its mark upon the non-ferrous metals market. In the case of copper, however, the "bullish" influence of this factor has been rather more than counterbalanced by tendencies operating in the reverse direction, and with the demand for the metal, especially for industrial purposes, showing little improvement values of standard brands have finished up on balance fractionally easier than they were a week ago. The rise in tin of the previous week has been fully maintained, and about 10s. per ton has been added to the prices current at last report, in spite of the fact that buying interest in this metal has continued on a restricted scale. The lead and spelter sections of the market have been about the most satisfactory during the past week, and in both instances relatively substantial advances have occurred. Lead has met with a moderate amount of inquiry, and the present tone of the market is steady, with quotations about 10s. per ton higher on balance. Spelter values are between 12s. 6d. and 15s. per ton in advance of those last quoted, and the demand for the metal this week has been on a somewhat improved scale.

Iron and Steel.

Russian trade uncertainties arising out of the intended termination of the agreement with this country have been a disturbing factor in Lancashire engineering during the past week, and buying interest from most of the principal steel-using industries in the district has been exceptionally small, with consumers restricting new commitments to immediate needs. Plates and bars of all descriptions, with the possible exception of bright-drawing bars, have been in poor demand. Boiler plates are maintained, however, at about £8 10s. per ton, with joists at £8 15s., sections at £8 7s. 6d., general plates at £8 17s. 6d., large diameter bars at £9 7s. 6d., and small re-rolled kinds at from £6 15s. to £7. The lower value of sterling in terms of Continental currencies has appreciably stiffened the prices of imported iron and steel materials quoted for delivery in the Manchester district, and in some instances the foreign products appear to be no longer on a seriously competitive basis. There has been no expansion of forward buying interest in the foundry iron market, and early delivery transactions remain the general basis. For delivery in the Manchester area, Derbyshire and Staffordshire brands of No. 3 are quoted at 67s. per ton, Northamptonshire at 65s. 6d., Scottish at about 83s. 6d., and West Coast hematite at 81s.

BARROW-IN-FURNESS.

Hematite.

In the hematite pig iron trade business remains about the same. There is still a lack of any evidence which would point to an improvement in the demand, but with so few furnaces in blast stocks are being depleted, and in due course production will have to be increased, as was the case at Millom a few weeks ago. Buyers are taking just enough for their present requirements, which are still on the light side. As for foreign business, there is still a weakness on this side of the market, and the same remark applies to America, which is not requiring much iron at present. The iron ore trade is quiet, and there is not much being brought up at the local mines; in fact, quite large stocks exist on the surface at one or two mines. Foreign ore is in quiet demand. The steel market remains dull, and the output from the district at present is very low. It is possible that there will be greater activity, especially in the rail production departments, in the course of a few weeks. The hoop and small section mills are employed at Barrow.

Motor Transport.

The Barrow Corporation recently added eighteen double-decked omnibuses to its fleet, half of which were driven by heavy oil, and has recently decided to convert the nine petrol-driven vehicles to heavy oil. According to figures issued by the Corporation, there is a saving on heavy oil over petrol of 2·302d. per omnibus mile over a period of twenty-four weeks, and this saving has increased to 2·741d. per omnibus mile over the last four weeks, as a result of the increase in the price of petrol.

SHEFFIELD.

(From our own Correspondent.)

Local Trade Situation.

There has been no change of note in the local trade situation, and the turnover fails to expand to any considerable extent. The heavy sections still constitute the weakest part of industry, and there has been a falling off in the demand for special steels. In the lighter and finished branches conditions have been improving for some time past, especially in cold-rolled strip, magnets, hacksaws, and high-grade mechanics' tools. There is some misgiving in engineering circles at the intention of the Government to end the Russian trade agreement. Manufacturers fear that such a step may check the expansion of business with the Soviet. Those best informed of the intentions of the Government, however, think that the old agreement will be replaced by a new one, in which British trade interests in Russia are not likely to be jeopardised.

A Russian Order.

It is announced that the order for a plant for producing railway wheels, which Davy Brothers, Ltd., of Sheffield, booked from the Soviet Government, will comprise three Davy patented high-speed steam-hydraulic forging presses of 2500, 3000, and 7000 tons respectively, which are to be used for punching and slabbing the sliced ingot block, and thereafter forming the shape of the wheel, and corrugating the wheel web after rolling. A high-power wheel rolling mill of the Edgewater type, constructed under the Bell patents, will be employed for finally rolling the rim and the tread on all four sides. The contract, of the value of £200,000, also includes all handling machinery and hydraulic plant required for carrying out all the processes in one heat. In financing this contract, the firm is receiving assistance from the Exports Credits scheme of the Government.

Good Orders.

As the result of the operation of tariffs, A. T. Green and Sons, Ltd., of the Northfield Engineering Works, Rotherham, have booked substantial orders from a German company for a steel works speciality which has not hitherto been manufactured in this country. The Central Electricity Board has placed with the Macintosh Cable Company, Ltd., of Derby, in connection with the South-West England grid scheme, an order for the supply, laying, and jointing of cables. The work is said to be of the value of over £100,000. Sheffield firms with whom the Admiralty has placed orders for cutlery include Atkinson Brothers, Ltd., Mappin and Webb, Ltd., and Sheffield Steel Products, Ltd.

New Selby Bridge.

Steps have been taken by the Selby Development Committee to urge the Government and county authorities to proceed with the scheme to build a new bridge over the river Ouse at Selby. The scheme was estimated to cost about £700,000. The plans have already been drawn up, but work has not yet begun, owing to the economic situation. The Development Committee is urging the Government to carry out the building at once, and leave the road question for the present. Not only East and West Riding traffic will benefit by the provision of the bridge, but national traffic also, as the main roads from Hull to the West Riding and Lancashire and from the south to the north would use it.

Lead Mine's New Life.

Lead ore is being produced at the rate of 800 tons a week from a depth of 600ft. below water level in the old Mill Close Mines, Darley Dale, Matlock. The Mill Close Mines, which have been in operation for over seventy years, have made several fortunes, but in recent years the output has been reduced to a minimum. With up-to-date machinery for pumping, however, lead was found in large quantities at the 93ft. level below water, and the mines are now being worked as low down as 103 fathoms (600ft. below water) with great success.

Cutlery and Plate Trades.

The Christmas season trade in cutlery and plate, which should now be in full swing, has not yet made its appearance. Activity in the cheapest lines has been stimulated by the placing of huge contracts for bazaar lines, and several firms which cater for this trade are overwhelmed with orders. Sheffield is producing cast steel scissors to retail at 6d.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Prosperous Times.

INDUSTRY in the North of England appears to have definitely entered upon more prosperous times. Orders valued at many thousands of pounds have been placed with Northern firms this week. The most outstanding is that placed by the West Ham Corporation with Dorman, Long and Co., Ltd., Middlesbrough, for a viaduct to be constructed in connection with the new road between Canning Town and Silvertown. The viaduct is to be 2 miles in length, and the contract price is in the neighbourhood of £300,000. Another important contract is that secured by C. A. Parsons and Co., Ltd., of Newcastle, from the Swansea Corporation for two 30,000-kW turbo-alternators for the new Tir John power station. The turbines will be of the Parsons reaction tandem-cylinder type, while the alternators will be made according to the Parsons patents, generating direct at 33,000 volts. This order follows upon the good results obtained at the Brimsdown power station of the North Metropolitan Electric Supply Company, Ltd., where a 25,000-kW Parsons turbine and alternator generating at 33,000 volts has been in operation for the past four years. A similar machine of Parsons manufacture is also in operation at the same station. Messrs. Parsons are the only firm in the world who have high-voltage turbo-type alternators in commercial operation. They are now manufacturing machines of this type for Cape Town, South Africa, and the South Wales Power Company. It is interesting to note that Swansea is the first capital power station to adopt direct generation at 33,000 volts. The value of the contract is about £150,000.

Steel Trade Developments.

The directors of the Skinningrove Iron Company, Ltd., have decided upon a scheme of development which will enable the works to play a more important part in the steel trade in the near future. In order to carry this scheme into effect, a brief suspension of operations in both iron and steel manufacture to enable the technical equipment to be reviewed and overhauled, and supplemented where necessary, has been decided upon. The firm will accordingly cease steel manufacture on November 5th. One of the blast-furnaces will be blown out and the other three at the works damped down. It is expected that the alterations will be completed to enable a full resumption of activities at the works early in March.

Ironworks Restarting.

After being closed down since July last, the Normanby Ironworks of Pease and Partners, Ltd., at Middlesbrough, are to be restarted. A number of men are at present engaged in preparing two blast-furnaces, and when their work is completed—which is expected to be within a fortnight—the furnaces will be put into operation on the production of hematite. The news of this rekindling is particularly welcome, in view of the temporary suspension of operations at the Skinningrove Iron and Steel Works, in which Pease and Partners have a proprietorial interest.

Cleveland Iron Trade.

There has been a slight expansion in the volume of business in the Cleveland iron trade this week. The stoppage of the Skinningrove blast-furnaces at the end of the month and the restarting of the Normanby Ironworks will have repercussions on the iron trade. The net result will be that only fifteen blast-furnaces will be in operation on the North-East Coast, as compared with seventeen at present. Moreover, it will leave only two blast-furnaces producing Cleveland iron. Obviously, this is an inadequate number, and whilst at Skinningrove consumers' needs can be met for some time to come out of stock, either more furnaces will have to be started elsewhere or others switched over from other classes of iron. Prices of Cleveland iron are inclined to firmness, but are unchanged at 61s. for No. 1 foundry, 58s. 6d. for No. 3 G.M.B., 57s. 6d. for No. 4 foundry, and 57s. for No. 4 forge.

Hematite Pig Iron.

The low price of East Coast hematite pig iron has made possible small sales to Italy and Denmark, whilst British steel makers have been placing orders a little more freely, though they still confine their purchases to early delivery. Mixed numbers keep fairly steady at 59s., and No. 1 quality at 59s. 6d.

Iron-making Materials.

Foreign ore is slow of sale. Consumers are disinclined to negotiate, as they have ample supplies, and sellers are not disposed to accept the low and unremunerative terms obtainable. Best Rubio ore is quoted at 14s. 6d., c.i.f. Tees. The changes at the ironworks will further limit the demand for furnace coke, and the price is very weak at 14s. 6d. delivered at the works.

Manufactured Iron and Steel.

In the manufactured iron and steel trade inquiries are increasing on both home and export account, and a more hopeful feeling exists. There is a much improved demand for sheets, and prices show a firmer tendency.

The Coal Trade.

Quieter conditions are the rule in the Northern coal trade. The recent brisk demand for Northumberland steam coal has not been maintained, and while the favourite descriptions are very substantially booked for this month's delivery, increasing supplies are on offer

for early November and later. For prompt delivery, odd lots still command up to 14s., but for November shipment 13s. 9d. appears to be the maximum, and through contractors this price might, according to shipment positions, be further discounted. Tyne prime steams are 12s. 9d. to 13s. 9d., and other classes 12s. to 12s. 6d. Smalls are on offer at 8s. to 8s. 6d. On the Durham side large steams are having a steady sale at 15s. to 15s. 1½d., with smalls at 11s. to 11s. 1½d. Gas coals are obtaining a fair share of seasonal trade, but it is not up to the average yet. Best qualities are quoted at 14s. 6d. to 14s. 7½d., and secondary at 13s. to 13s. 6d. Demand for special bunker qualities is good, and sellers realise 14s. For other best grades the position is quiet at 13s. 9d. to 14s., and for ordinary descriptions at 13s. Coking unscreened and smalls are almost neglected, sellers offering plentifully at 12s. 6d. to 13s. 3d. In the coke export section there is a continued healthy tone. Another cargo of coke nuts amounting to 3500 tons has been sold to the United States. This fuel is in good inquiry at 16s. 6d. to 17s. 6d. Durham patent coke was so heavily sold earlier in the autumn for delivery over the winter that there is not much more trade to be got at the moment. The business done is much in excess of what was recorded a year ago. The price of good ordinaries is very steady at 15s. 4½d. to 15s. 6d. Gas coke has been so extensively sold that there is now a scarcity of it. The nominal price is 18s. to 18s. 6d., and more would be asked if supplies were available.

SCOTLAND.

(From our own Correspondent.)

Steel.

It cannot be said that the works concerned in the production of heavy steel have yet experienced any tendency towards an expansion in business. Home demands are paltry and export requirements are of a very restricted nature. On the other hand, the recent improvement in the light steel branches is fully maintained, and prospects of further expansion are bright.

Steel Sheets.

Steel sheets of the lighter gauges have received some good orders on home and foreign account, and producers are much better employed than they have been for some time. Black sheets of 24 gauge are quoted at a minimum of £8 5s. for export and £9 10s. per ton for home use, and galvanised corrugated sheets of 24 gauge are £11 for home delivery and £10 per ton export, except to Canada, for which the price is £10 15s. per ton.

Steel Tubes.

Tube makers participate to a slight extent in the improved demand. The export turnover has been a little better, while inquiries are on a more generous scale.

Bar Iron.

Depressed conditions still characterise the bar iron trade. "Crown" bars are quoted £9 15s. home (fixed) and £9 5s. per ton export, and these quotations are evidently not attractive to consumers. Re-rolled steel bars meet stern competition from Continental material, and here again makers find considerable difficulty in doing business at £6 10s. per ton home (fixed) and £6 5s. per ton export. It is thought, however, that with the tariffs now fixed for a period of two years and the uncertainty of the past three months in this respect removed, business will take a turn for the better.

Scrap.

Scrap material is easier, with heavy steel on the basis of 35s., and cast iron machinery from 42s. 6d. to 45s. per ton.

Coal.

Export prices for Scottish coal are firmer than they were a week ago, and the market is strong all round. The probability of a scarcity of supplies owing to the reduction of outputs under the quota system becomes more and more evident. Some pits in Fifeshire have closed in order to avoid over-production, and this at a time when both home and export requirements are increasing. All Fifeshire fuels are difficult to secure, and Lothians steams and smalls are not too plentiful now. Under the circumstances, shippers are proceeding with caution, and business is mostly of a restricted day-to-day description. Lanarkshire and Ayrshire large coals are still in fair supply, but, nevertheless, are advancing in price, as in other districts. Washed nuts of all sizes are very scarce, especially Fifeshire trebles, and quotations show a firm upward tendency. Aggregate shipments amounted to 255,890 tons, against 256,191 tons in the preceding week, and 255,745 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

To judge by the tonnage position alone the coal trade has been better placed during the past week. No doubt many collieries have benefited by the arrival of steamers which should have turned up earlier, but were delayed by bad weather. At the end of last week there were thirty-six idle tips at the docks between Newport and Port Talbot, but as the result of arrivals over the week-end this total of idle appliances was reduced to nineteen, though on Tuesday the number increased to twenty-three. Still, this record is much better than it has been for some time, though the indications point to the improvement being only temporary. The anthracite section of the industry has stood out conspicuously from the point of view of its strength. At the end of last week all berths at Swansea were occupied, and there were eleven steamers waiting to berth. On Monday the number of waiting vessels rose to twenty-one, though on Tuesday the total declined to fourteen. Still, this is sufficient to indicate the loading pressure, which, though it may vary to some extent, will almost certainly continue to the middle of November, by which time the last steamers being loaded for Montreal will be sailing in order to make sure of getting away from the river St. Lawrence before the ice closes navigation. The returns of the G.W.R. Company for both steam and anthracite coals shipped from the six docks in this area under its control were not quite as good as expected last week, as the total only came to 381,305 tons, as compared with 403,430 tons for the preceding week, and with 453,705 tons for the corresponding period of last year. The demand from abroad for early shipment does not present much in the way of new features, except that France is taking all the anthracite coal and dry sized coals that can be secured. The news regarding business for the Irish Free State is not so satisfactory, as it is reported that there is a prospect of the 5s. tax on coals from the United Kingdom being increased. Contract operations have claimed more attention and it is now confirmed that the order from the Egyptian State Railways for 22,000 tons of sized coals for early delivery has been placed with Moxey, Savon and Co., of London and Cardiff, and this firm has commenced taking up tonnage to fulfill the contract. Tenders went in on Monday for the requirements of the Portuguese State Railways for 270,000 tons of small coals for delivery at Portuguese ports from November of this year to December, 1933, and from the information to hand it was expected that the order would be placed with two or three Cardiff firms. The Royal Danish Navy is also in the market for a cargo of 3000 tons of large coal, but, apart from this, there was no other notable contract business pending, though it is reported that the Algerian State Railways may shortly be inquiring for prices for 250,000 tons of patent fuel.

Cardiff's Shipping Appliances.

The deputation appointed by the Cardiff Corporation to interview the general manager of the Great Western Railway Company on the question of the closing down of certain coal-loading appliances at Cardiff, visited London on Monday. The allegation made against the company was that it had not kept its pledge, given in 1921, that the amalgamation of the railways in this area would not be operated to the prejudice of Cardiff in relation to the other ports in this Channel. The interview with the general manager of the company lasted 2½ hours, and was of a private character. It is, however, understood that the whole position was reviewed, and that Sir James Milne promised to give full consideration to certain points put before him, but he adhered to his contention that the company had honoured its pledge to Cardiff and had treated the city very fairly.

Miscellaneous Items.

On the advice of the Executive Council of the South Wales Miners' Federation and the miners' lodge officials, notices signed by a thousand workmen at the Bedwas Colliery were not handed in on Monday as had been intended, pending further negotiations in the dispute regarding the re-employment of displaced workmen. The Brynna Wood Colliery, Llanharan, has resumed operations after being idle for several months, during which period the mine has been electrically equipped. It is announced from Swansea that the Rose Patent Fuel Works, King's Dock, which have been idle since April, were to reopen this week. The announcement of the Treasury Order extending for two years the existing 33⅓ per cent. duties on iron and steel has caused satisfaction in South Wales, and the rumour is current that the duty is likely to be shortly raised to 50 per cent. The South Wales Institute of Engineers holds its annual engineering exhibition in the Greyfriars Hall, Cardiff, from November 23rd to December 3rd.

Swansea's Electricity Contract.

On Friday last, the Swansea Borough Council placed a contract for the turbo-alternators for the Tir John North super power station, now being erected, with C. A. Parsons and Co., Ltd., of Newcastle-on-Tyne, their price for a 33,000 volts equipment being £139,599. The Electricity Committee's recommendation was that the 11,000 volts scheme should be adopted and that the tender of the English Electric Company, Ltd., at £133,644 be accepted.

Current Business.

Operations in steam coals for early shipment have not materially expanded, and the demand for large coals remains extremely quiet, but sized coals of low volatile description fully maintain their firmness, supplies being very difficult to obtain for anything like prompt loading. Patent fuel is fairly well stemmed, and coke moves off freely; but the market for pitwood is quiet, with prices just about steady.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Mr. G. N. Gubst, late managing director of Hollings and Guest, Ltd., and Hands and Sons, Ltd., has joined Tangyes Ltd. in connection with their hydraulic machinery activities.

Holden and Brooke, Ltd., inform us that the staff at their London office, 562/564, Abbey House, Westminster, S.W.1 (telephone, Victoria 7407), has been strengthened by the addition of Mr. T. L. Hale, who has previously been at the head office, Manchester, in charge of the heater, calorifier, and heat transfer departments.

John A. Sheeton, Ltd., steel works and foundry engineers, of 15, Victoria-street, London, S.W.1, have just appointed as their district agents the following:—Wm. H. Flood and Co., Ltd., Prudential Buildings, Pinstone-street, Sheffield, 1, for Derbyshire, South Yorkshire, and Staffordshire; Mr. C. H. Faris, 2, Mariand-avenue, Cheadle Hulme, for Lancashire and Cheshire; and Mr. J. Glanville Davies, Llwyncelyn, Hafod, Llanelly, for South Wales.

EDUCATIONAL INTELLIGENCE.

Technical College, Bradford: Session 1932-33.—The following lectures in connection with the College course in welding engineering have been arranged. Engineers and others interested in welding construction are invited to attend. Monday, October 24th, at 7.30 p.m., lecture on "Electric Arc Welding," by Mr. E. F. Newell, chief metallurgist of the Quasi-Arc Company, Ltd., London; Tuesday, November 8th, at 7.30 p.m., lecture on "Electric Welding as Applied to Bridges and other Steel Structures on the L.N.E.R.," by Mr. H. Bruff, of the staff of the North-Eastern area of the L.N.E.R.; Monday, November 28th, at 7.30 p.m., in conjunction with the Bradford Engineering Society, a cinematograph film on "Metal Treatment by the Oxy-acetylene Process," lent by the Acetylene and Welding Consulting Bureau, Ltd., London. Admission is free to all lectures.

CATALOGUES.

Davidson and Co., Ltd., Belfast.—Publication S.F. 25 on "Sirocco Products."

John Spencer, Ltd., Wednesbury.—New high-pressure steam main catalogue.

Skefko Ball Bearing Company, Ltd., Luton.—New general catalogue of ball and roller bearings.

English Steel Corporation, Ltd., Vickers Works, Sheffield.—A brochure on "Visco" steel castings.

Siemens Bros. and Co., Ltd., Woolwich, S.E.18.—Pamphlet 480A, entitled "Wireless Telephony at Sea."

Joseph Booth and Bros., Ltd., Rodley, Leeds.—Particulars of the firm's safe load indicator for all types of cranes.

Aerograph Company, Ltd., Lower Sydenham, S.E.26.—Catalogue on the Aerograph and the De Vilbiss spray painting and finishing equipment.

Consolidated Pneumatic Tool Company, Ltd., 170, Piccadilly, W.1.—Sectional loose-leaf catalogue of pneumatic tools of all types and for all purposes.

Richardsons, Westgarth and Co., Ltd., Hartlepool.—Brochure A.T.I., giving particulars of Richardsons, Westgarth-Brown, Boveri turbo-alternators.

CONTRACTS.

The Netherland Shipbuilding Company, Amsterdam, has signed a contract to built a motor cargo and passenger vessel for the United Netherlands Steamship Company, of the Hague. The ship will have a deadweight of 8600 tons. The engines, of 8300 H.P., will be supplied by Machinefabriek Gebr. Stork and Co., Hengelo, Holland.

Yarrow and Co., Ltd., have received an order from the Burmah Oil Company for an oil-fired, water-tube boiler, with air pre-heater, to be manufactured at Glasgow and shipped in pieces for re-erection in Burmah. The boiler is designed for a normal evaporation of 25,000 lb. per hour, a working pressure of 190 lb. per square inch, and steam temperature of 500 deg. Fah.

Institution of Naval Architects.—The Council of the Institution of Naval Architects has made the following awards:—Parsons Scholarship in Marine Engineering (1932), to Mr. Allan M. Baxter, of G. and J. Weir, Cathcart, Glasgow. The scholarship is of the value of £150 per annum and will be held at Glasgow University for four years. Denny Scholarships in Naval Architecture and Marine Engineering (1932), the Naval Architecture Scholarship to Mr. John R. White, of Macclesfield Grammar School; and the Marine Engineering Scholarship to Mr. K. F. Leonard, of the Ealing County School, London. Both scholarships are of the value of £75 per annum and will be held at Glasgow University for four years. Duke of Northumberland Prize (in connection with the 1932 examinations for National Higher Certificates in Naval Architecture), to Mr. Norman Holey, of the Technical College, Sunderland.

Mollier Diagram for Saturated and Superheated Steam.—We have received from the publishers, Edward Arnold and Co., of London, a copy of a new entropy-total heat diagram which they have recently issued at a price of 1s. net, or 1s. 2d. by post in a tube. The diagram has been plotted by Mr. G. S. Callendar from the values obtained from the Callendar equations for the properties of steam. The scale of entropy measures about 14in. in length and is marked from 1·4 to 2·1, the major divisions being at intervals of 0·1 and the minor at the somewhat inconvenient figure of 0·004. The total heat scale extends from 450 calories to 800 calories, the major divisions being at intervals of 50 and the minor at intervals of 2 calories. The lines of constant pressure range from 0·2 lb. to 1000 lb. per square inch. Above the saturation line the lines of constant superheat extend from zero to 330 deg. Cent. Below the saturation line the lines of constant quality range from 100 per cent. dry to 72 per cent. dry.

The Chartered Institute of Patent Agents.—In commemoration of the jubilee celebrations of the Chartered Institute of Patent Agents, which was founded in 1882 and incorporated by Royal Charter in 1891, a dinner was held at the Hotel Victoria on Wednesday evening last. The chair was taken by the President, Mr. F. Gilbert Brettell, and there was a company of about 300 members, guests, and their ladies. The evening was a most successful one in every way, excellent arrangements being made, and the dinner was followed by a dance. The toast of "The Chartered Institute of Patent Agents" was fittingly proposed by the Comptroller-General of Patents, Designs and Trade Marks, Sir William S. Jarratt. In his speech, Sir William referred to the work of the Council with which he had been in touch during thirty-eight years of official life. He paid a tribute to the way in which the work of the Institute had guarded the public interest, supported and improved the position of inventors and upheld the dignity of the profession. Fifty years ago, he recalled, there was no motor car, aeroplane, wireless, or cinema, and among those present were many who had given a helping hand to these and many other important inventions. He went on to trace the development in British patent law, and said that the new Patents and Designs Act, which would come into force next Tuesday, would enhance the prestige of British patent law and incorporate the best features of the American and German systems. It was important to remember that the new law coincided with a change in our fiscal system, which would encourage invention and manufacture in our own country. The President, Mr. F. G. Brettell, responded and read congratulatory telegrams from other countries. He alluded to the support which the Institute had received from the inventors and large firms interested in the development of invention. The success of trade, he suggested, was bound up with the development of scientific invention. The toast of "Our Guests" was proposed by Mr. A. A. Thornton in a happy speech, and was replied to by Justice the Hon. Sir Harry T. Eve and Dr. Leslie Burgin, Parliamentary Secretary to the Board of Trade.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/6 to 20/-
(1) Spanish	17/- to 23/6
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	14/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 7 6	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. Coast—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
Lancs.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ¾in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 0 0
„ „ „	For Canada	10 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0 to 7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0 to 8 12 6	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 7 6 to 6 12 6	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets	11 5 0 to 12 15 0	10 0 0
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

Swansea—		
Tin-plates, I.C., 20 by 14	f.o.b.	15/9 to 16/-
Block Tin (cash)		153 10 0
„ (three months)		153 15 0
Copper (cash)		31 11 3
„ (three months)		31 13 9
Spanish Lead (cash)		11 18 9
„ „ (three months)		12 3 9
Spelter (cash)		15 3 9
„ (three months)		15 8 9
Manchester—		
Copper, Best Selected Ingots		35 5 0
„ Electrolytic		36 15 0
„ Strong Sheets		65 0 0
„ Tubes (Basis Price), lb.		0 0 10
Brass Tubes (Basis Price), lb.		0 0 9
„ Condenser, lb.		0 0 11½
Lead, English		14 0 0
„ Foreign		12 7 6
Spelter		15 7 6
Aluminium (per ton—raw ingot)	£95	

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£22 5 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 10 0	11/-
„ „ „ 1 p.c. carbon	£42 12 0	14/-
„ „ „ 0·70 p.c. carbon	£44 0 0	16/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/-
„ „ Ell	14/6
„ „ Splint	14/- to 16/-
„ „ Trebles	14/6 to 15/-
„ „ Doubles	12/6
„ „ Singles	11/-
Ayrshire—	
(f.o.b. Ports)—Steam	11/6
„ „ Jewel	16/6
„ „ Trebles	14/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/6 to 13/6
Screened Navigation	16/- to 16/6
Trebles	17/- to 18/-
Doubles	13/- to 14/-
Singles	11/-
Lothians—	
(f.o.b. Leith)—Best Steam	12/- to 12/6
Secondary Steam	11/- to 11/6
Trebles	15/-
Doubles	12/- to 13/-
Singles	10/6 to 11/-

(8) N.W. Coast— ENGLAND.

Steams	20/- to 21/-
Household	32/6 to 52/6
Coke	19/- to 22/6
Northumberland—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
Durham—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

Sheffield—	Inland.	Export.
Best Hand-picked Branch	27/- to 28/-	—
South Yorkshire Best	23/- to 24/-	—
South Yorkshire Seconds	19/- to 21/-	—
Derbyshire Best House	22/- to 23/6	—
Derbyshire Best Brights	18/- to 20/-	—
Screened House Coal	18/- to 19/-	—
Kitchen Coal	16/6 to 17/6	—
Best Screened Nuts	17/- to 18/6	—
Small Screened Nuts	16/- to 16/6	—
Yorkshire Hards	17/- to 18/-	—
Derbyshire Hards	17/- to 18/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/- to 8/6	—

Blast-furnace Coke (Inland) 10/- on rail at ovens

Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 31/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	20/-
Pitwood (ex ship)	21/6 to 22/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	38/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	37/6 to 48/6
Nuts	38/6 to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	9/9 to 10/6
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Compagnie Generale Transatlantique.

THE long-expected plan for the reconstruction of the Compagnie Générale Transatlantique has been presented to the Government by Monsieur Léon Meyer, Minister of the Merchant Marine, and it is admitted that he has performed a very difficult task in a highly creditable manner. The affairs of the company appeared to be hopelessly entangled with inflated assets and huge liabilities, many of them of a character that necessitated inquiry, and also with subsidiary concerns that were making profits out of the parent company when it was itself in the throes of financial disaster. The first thing to do was to suppress those companies which were merely suppliers to the C.G.T. Then Monsieur Meyer wrote down the assets by 1000 million francs, and more than offset that amount by wiping out the reserves and compounding with creditors for a reduction of 60 per cent. of what was due to them, this being rendered possible by the dubious character of many of the claims, while the suppression of the subsidiary companies helped to bring up the savings to nearly 150 million francs in excess of the amount written off for depreciation of assets. It is proposed to create new capital by the issue of privileged shares to the value of 180 million francs which will be used partly for a settlement of liabilities, and it is believed that with the aid of the State subsidies and with the economies being effected it will be possible before long to wipe out the working losses. During the past year there has been severe retrenchment in all the company's departments. Some of the lines have been suspended and the methods of dealing with the traffic reorganised, so that where losses were inevitable they were reduced to a minimum. The economies this year have amounted to 220 million francs, and the working loss is said to be not more than 60 millions, as compared with 300 millions at the time of the collapse. When the plan submitted by Monsieur Meyer has been approved of, there will presumably be an end to the direct State control or management of the Compagnie Générale Transatlantique, and another Board of Directors will be appointed, so that the company will again become autonomous, though still under the control of the State.

Shipbuilding.

When the "Normandie" leaves the stocks at Saint-Nazaire to-morrow (Saturday) there will be a great void in the shipyards which will only have about 36,000 tons under construction, with little prospect of new orders except a liner for the Messageries Maritimes and three cargo boats. This absence of new orders, apart from submarines and other light craft being given out under the programme of naval construction, is causing anxiety to builders, who point to the "Normandie" as an example of what can be done for the shipbuilding industry. It provided employment for about 3000 men during a period of four years, besides many thousand others in the engineering and other industries. This is not the moment, it is said, when shipbuilding should be suspended for reasons of economy. When traffic revives it will be attracted to modern vessels, and a policy of modernising the fleet is being adopted by the Messageries Maritimes, which, at the end of the year, will have six oil-engined liners running to the Far East, to be followed by a seventh that will be built, like the others, at the Seyne shipyard of the Forges et Chantiers de la Méditerranée. The finest ship on this line was the "Georges-Philippar," which was destroyed by fire a few months ago. Last week the 21,500-ton liner "Aramis" left Marseilles on its first voyage to the Far East, and the "Maréchal-Joffre," of the same class, will be put into service in two or three months' time. The "Aramis" has two Sulzer two-cycle engines developing together 14,000 horse-power. A feature of this ship is the joining of the two funnels near their upper extremities by a bridge, so that they are barely visible. This arrangement gives the impression of a high top deck amidships. The Navigation Mixte is also modernising its fleet for the traffic with North Africa, and French shipbuilders argue that other companies should follow their example, for not enough is being done to make good the depreciation of the 3,500,000 tons of shipping which is largely laid up and will be of little value in the competition for traffic in the future.

Machine Tools.

French makers of machine tools have been endeavouring for a long time past to obtain an assurance from the Government that all orders for the public services, such as arsenals, railway companies' works and the like, should be placed with them. There are obvious difficulties in the way of giving complete satisfaction to home makers, for the reason that orders which have gone abroad have been largely for special machines that are not manufactured in this country, and if ordered from home firms they would have to be designed and built under conditions that would not offer the same guarantee and would certainly be higher in cost. Nevertheless, French makers have just grouped themselves into an association with the object of insisting upon their claims. This does not trouble British machine tool makers at a time when the French business has fallen to so low an ebb that hardly anything is being done, and importers are satisfied that they could hold their own in this market if they did not labour under the disability of the 15 per cent. super-tax which remains a serious impediment to British trade. Before there can be any hope of doing business under highly competitive conditions, the super-tax must be removed and the pound stabilised. It is difficult to do business under uncertain and fluctuating conditions. The pressure which French machine tool makers are bringing to bear upon the Government will certainly have some effect upon the negotiations now proceeding for a treaty of commerce with Great Britain, though, in a general way, the official point of view now favours an interchange of goods that will afford the greatest benefit to essentially French industries even when others, that can only exist under cover of abnormal protection, may have to suffer. Still, the bargaining is bound to be very keen, and it is desirable that British machine tool makers should be put on an equal footing with other foreign competitors, which is not the case when it is found that with the super-tax it is impossible to get near the prices at which German machine tools, for example, are sold.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

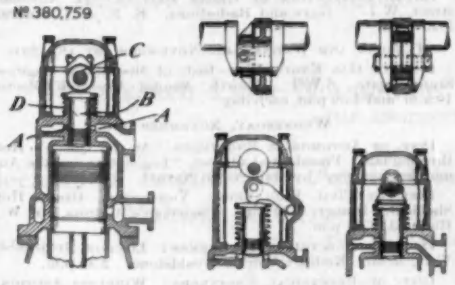
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

380,759. May 6th, 1932.—TWO-STROKE ENGINES, V. Mickelsen and E. Moller, of Harland and Wolff, Ltd., Belfast, and F. E. Rebbeck, of Harland and Wolff, Ltd.

This invention is concerned solely with the exhaust arrangements of a two-stroke engine, which are situated at the top of the cylinder at A A. These ports are controlled by the auxiliary

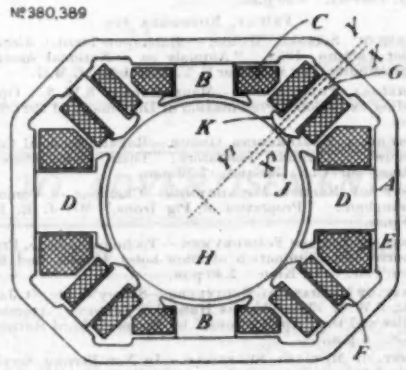


piston B, which is subject, at the bottom, to the pressure in the main cylinder, but is controlled in its movement by the cam shaft C. This cam shaft is geared with the main crank shaft so that the opening and closing of the exhaust valves will coincide with the cycle of the engine. A spring D is provided to keep the auxiliary piston in contact with the cam.—*September 22nd*, 1932.

DYNAMOS AND MOTORS.

380,389. April 14th, 1932.—D.C. DYNAMO-ELECTRIC MACHINES WITH INTERPOLES, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C.2; and John Westgarth Voelcker, of 5, Beechwood-avenue, Shipley, Yorks.

This invention relates to multipolar D.C. dynamo-electric machines having interpoles and designed to occupy a space that is very restricted, more particularly in one direction. The object is to produce, in a symmetrical frame, a compact machine in which the waste space between the interpoles and the main poles is reduced to a minimum, without disturbing the required distribution of flux in the air gap. The octagonal carcase A forming the magnetic yoke has greater width than height. The two vertical poles B, with their coils C, are shorter than the two horizontal poles D with their coils E. Each interpole coil F is placed with one edge close to the adjacent horizontal part of the yoke and is of as large a diameter as can be accommodated between the main field coils C and E. The latter may be

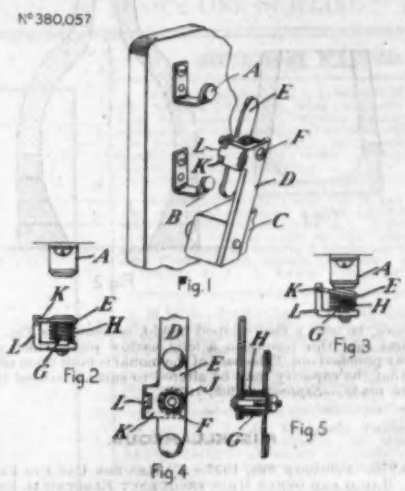


wound with less turns in the outer than the inner layers so as to form stepped or bevelled coils. The result of this disposition of each interpole is that the centre line X X¹ of the core G of each upper interpole falls below the neutral axis Y Y¹, where Y¹ is the centre of the armature H, while the centre line of each lower interpole comes above the neutral axis. Each interpole shoe is unsymmetrical with respect to its core and coil, the upper shoes being displaced upwards and the lower downwards. Adjacent shoes are shifted in opposite directions round the armature. Generally, the face of the shoe will be symmetrical about the neutral axis, the shoe tapering towards the tips away from the air gap. In order that it may overlap the coil, the back of the shoe may have to be unsymmetrical about the neutral axis, in which case if the main pole shoes are symmetrical, the interpole shoe will be nearer to one of the adjacent main pole shoes than to the other. To prevent excessive flux leakage on the nearer side the shoe is tapered at J on that side down to a thinner edge than that given by the taper K on the other side.—*September 15th*, 1932.

SWITCHGEAR.

380,057. June 4th, 1931.—ELECTRIC SWITCHES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.*

The object of this invention is to prevent the contacts of switches of the bridging contact type "sticking" or "freezing" together under the heaviest service. The description of the switch given is as follows:—The stationary contacts are shown at A and B. A movable member C is attached to an arm D which supports the moving finger E carrying the bridging contacts. Fastened to the arm D by means of a screw F is a stub or supporting member G, upon which the moving finger E is slidably mounted. A spring H biases the moving finger E to the end of the stub member and against a portion J thereof away from the arm D. The finger E is provided with a U-shaped projection K at one side. This projection co-operates with a projection L formed on the arm D. The action of the contacts during engagement is described below. Fig. 2 represents the stationary contact and the movable contact before engagement of the bridging member with the stationary contacts. As the contacts on the movable finger E move into engagement with the stationary contacts A and B the flat surfaces of the contacts engage with each other. It is at this moment that the large rush of current passes through the contacts, and if there is any tendency for the metal to melt, this action will take place at this time. As the arm D continues to move further in, forcing

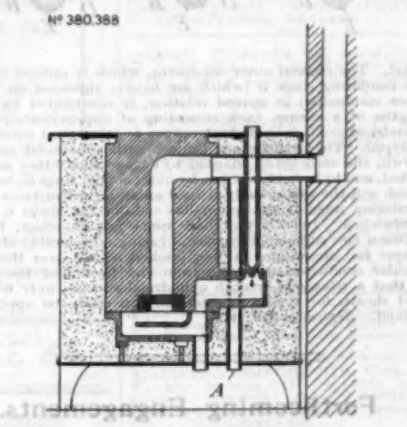


the contacts into closer engagement, the projection K engages the projection L and tilts the finger E, as shown in Fig. 3, placing the spring H under compression. This tilting action breaks any slight weld that may have taken place when the contacts were temporarily placed in a slightly plastic state. When the switch is opened the contacts easily pass out of engagement with each other. The inventors claim to have provided a positive means for preventing "freezing" of the contacts during operation of the switch.—*September 8th*, 1932.

FURNACES.

380,388. April 9th, 1932.—STOVES OF THE HEAT-ACCUMULATING TYPE, Svenska Aktiebolaget Gas-accumulator, Lidingö, near Stockholm, Sweden.

This invention is primarily concerned with what the inventors describe as heat-accumulating stoves in which, it appears, oil is burned slowly with the minimum of air necessary for combustion, and the combustion chamber is surrounded by a massive metal casting, for storing the heat. The inventors

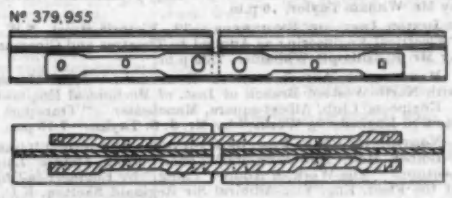


find that in such circumstances, when the flue-gas temperature approximates that of the atmosphere, so much water vapour is developed in the flue gases that, in conjunction with any sulphur which may be contained in the fuel burned, sulphuric acid is formed, to the detriment of the flues. They, consequently, adopt an additional air inlet A, which reaches the flue after the zone of combustion. The air passes through this inlet, is warmed in its passage, and so dilutes the flue gases that the sulphur passes away as gaseous SO_2.—*September 15th*, 1932.

TRAMWAYS AND RAILWAYS.

379,955. January 7th, 1932.—FISH-PLATES FOR RAILS, Société Anonyme d'Angleur-Athus, Tilleur, Belgium.

The assumption is that this type of fish-plate is specially applicable to Vignoles rails. The object is to provide a support for the ends of the rails, which will follow up any wear between the bearing surfaces between the fish-plates and the rails. As



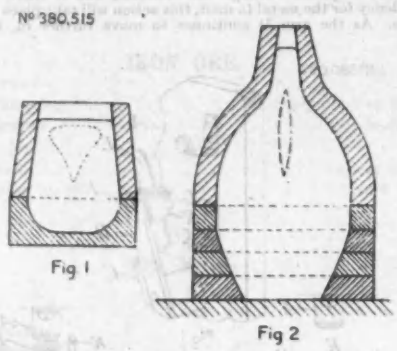
is shown in the drawing, the fish-plate has a waist on either side of the joint, through which one of the bolts is threaded. This waist cannot touch either the head or the flange of the rail, so that when the bolt is tightened up there is a resilient tendency to draw the central, active, part of the fish-plate up into tight contact with the rail.—*September 8th*, 1932.

METALLURGY.

380,515. June 10th, 1931.—INGOT MOULDS, Dr. B. Matuschka, 94 Mongigasse, Ternitz, Lower Austria.

This invention is concerned with the casting of steel ingots for the manufacture of railway tires. The inventor points

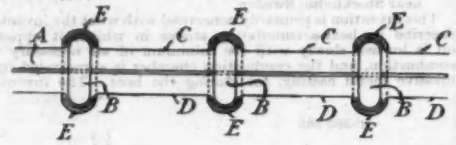
out that it is usual to cast such ingots in an open mould, as shown in Fig. 1, but this results in the pipe in the centre of the ingot being of comparatively large diameter, while it may not be central, so that when the centre of the ingot is punched out the whole of the pipe may not be removed. As a consequence, he uses a flask-shaped mould, as shown in Fig. 2, and claims that this results in a long narrow pipe, which can be easily punched out. The base of the mould is built up in sections, so that the capacity may be altered to suit the size of the tire to be made.—*September 19th*, 1932.



MISCELLANEOUS.

379,976. February 8th, 1932.—Cables for Use for Feeding Radio and other High-frequency Electrical Energy, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 12–13, Hallesches Ufer, Berlin.

According to this invention, a high-frequency cable, suitable for feeding radio and other high-frequency electrical energy, consists of a flexible inner conductor arranged within and insulated and spaced from an outer conductor by means of spaced insulators, the outer conductor consisting of relatively short rigid sections ball-jointed together. A is a flexible inner conductor upon which rings or beads B of porcelain or other suitable insulating material are threaded. The insulating rings or beads B may be slitted laterally, so that they can be easily pushed on to the inner conductor A sideways. The inner conductor A may be formed if desired of two wires twisted together, the twisting serving or helping to space the insulating beads



apart. The coaxial outer conductor, which is utilised to hold the insulating rings B (which are loosely threaded on to the inner conductor) in spaced relation, is constituted by short lengths of a casing, each consisting of approximately semi-cylindrical shells C D of sheet copper or other good conducting material. These shells are formed with spheroidal ends, as shown, the ends being adapted to engage each other as illustrated, and to be held together by outer copper rings E, between which and the spheroidally shaped outer curved surfaces of the insulating rings B the spheroidal ends of the shells C D are sandwiched. In this way ball joints are, in effect, formed between two successive lengths of casing. Preferably strips of copper foil are wound in long pitched helices over the outer tubular conductor or casing from end to end of the cable, so that a relatively smooth cylindrical surface, over which a lead sheath for weather protection can easily be applied, is formed.—*September 8th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME AND PLACE *at which the meeting is to be held should be clearly stated.*

To-day.

Inst. of Chemical Engineers.—At Inst. of Civil Engineers, Great George-street, S.W.1. First Hinckley Memorial Lecture. "Chemical Engineering and the Aircraft Industry," Mr. H. T. Tizard, F.R.S. 6.30 p.m.

Inst. of Electrical Engineers: London Students.—Savoy-place, W.C.2. "What of the Future? With Electro-farming as an Illustration," Mr. R. Berlase Matthews. 6.15 p.m.

Inst. of Mechanical Engineers.—Storey's Gate, St. James's Park, S.W.1. General meeting, Presidential Address, by Mr. William Taylor. 6 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. "Electrical Engineering as Applied to Theatres and Cinemas," by Mr. R. Gillespie Williams. 7.30 p.m.

Manchester Association of Engineers. Joint Meeting with North-Western Branch of Inst. of Mechanical Engineers.—Engineers' Club, Albert-square, Manchester. "Transport in Modern Engineering Works," by Mr. J. S. Taylor. 7.15 p.m.

North-East Coast Inst. of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. First Andrew Laing Lecture. "The Work of Andrew Laing," by Engineer-in-Chief of the Fleet, Eng. Vice-Admiral Sir Reginald Skelton, K.C.B. 6 p.m.

Soc. of Consulting Marine Engineers and Ship Surveyors: Scottish District.—39, Elmbank-crescent, Glasgow, C.2. "Horizontal Balanced Slide Valve," Mr. James Andrews, 7 p.m.

Saturday, October 29th.

Inst. of Metals: Birmingham Local Section.—Queen's Hotel, Birmingham. Dinner and dance. 7 p.m.

Monday, October 31st.

Bradford Engineering Society.—Technical College, Bradford. "Oil Firing for Steam-raising Purposes," by Mr. F. L. Bolt. 7.30 p.m.

Engineers' German Circle (Deutscher Ingenieurzirkel in London).—At the Inst. of Mechanical Engineers, Storey's-gate, St. James's Park, S.W.1. "Neue Konstruktionen von Dieselmotoren" ("New Designs of Diesel Engines"). Illustrated with lantern slides, by Diplom-Ingenieur R. E. Strub. 5.15 p.m. for 6 p.m.

Tuesday, November 1st.

Business Research and Management Association of Great Britain.—Anderton's Hotel, Fleet-street, E.C.4. "Industrial Revival Through Regional Planning," Mr. Hugh Quigley. 6.45 p.m.

Inst. of Automobile Engineers.—At Royal Soc. of Arts, Adelphi, W.C.2. "Repairs and the Importance of the Repair Department," Mr. S. H. Troughton. 7.45 p.m.

Inst. of Civil Engineers.—Great George-street, S.W.1. Presidential address, Sir Murdoch Macdonald. Presentation of medals. 6 p.m.

Inst. of Electrical Engineers: S. Midland Students.—The University, Birmingham. "Mercury Arc Rectifiers," Mr. H. Rissik. 7 p.m.

North-East Coast Inst. of Engineers and Shipbuilders: Graduates' Section.—Bolbec Hall, Newcastle-upon-Tyne. Résumé of Presidential Address by Mr. R. J. Walker. Paper, "Electric Steering Gears," by Mr. W. S. Paulin. 7 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, W.1. "Rays and Radiations," E. N. da C. Andrade. 5.15 p.m.

Tuesday and Wednesday, November 1st and 2nd.

Inst. of Gas Engineers.—Inst. of Mechanical Engineers, Storey's-gate, S.W.1. Fourth Annual Research Meeting. 10 a.m. and 2.30 p.m. each day.

Wednesday, November 2nd.

Inst. of Automobile Engineers.—At the Queen's Hotel, Birmingham. Presidential address, "Legislation and the Automobile Engineer," by Major C. G. Nevatt. 7.30 p.m.

Inst. of Civil Engineers: Yorkshire.—Grand Hotel, Sheffield. Dinner, 6.30 p.m. Chairman's Address, Mr. W. J. Hadfield, 7.30 p.m.

Inst. of Electrical Engineers: London Students.—Visit, Messrs. Kodak's Works, Wealdstone. 2.30 p.m.

Inst. of Electrical Engineers: Wireless Section.—Savoy-place, W.C.2. Chairman's Address, Mr. L. B. Turner. 6 p.m.

Inst. of Heating and Ventilating Engineers.—In the Lecture Room at the Home Office Industrial Museum, Horseferry-road, Westminster, S.W.1. "Radiant Heat," by Mr. A. F. Dufton. 7 p.m.

Inst. of Physics.—At Royal Inst. of Great Britain, 21, Albemarle-street, W.1. "Physics in Meteorology," Dr. G. C. Simpson, F.R.S. 5.15 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C.2. "Beauty in Industry," Mr. J. A. Milne. 8.30 p.m.

Thursday, November 3rd.

Inst. of Automobile Engineers.—Merchant Venturers' Technical College, Bristol. "Hydraulic Brakes for Motor Vehicles," Mr. F. G. Parnell. 7 p.m.

Inst. of Civil Engineers: Birmingham and District.—Chamber of Commerce, Birmingham. Chairman's Address, Prof. C. Batho. 6 p.m.

Inst. of Electrical Engineers.—Savoy-place, W.C.2. "Electric Lighting of Buildings," Mr. A. B. Read and Dr. J. W. T. Walsh. 6 p.m.

Inst. of Electrical Engineers: London Students.—Carr's Restaurant, Strand, W.C.2. Smoking concert. 7.15 p.m.

Inst. of Electrical Engineers: S. Midland Students.—Visit to W. and T. Avery, Ltd., Soho Foundry, Birmingham. 2.45 p.m.

Royal Aeronautical Society.—Royal Society of Arts, John-street, Adelphi, W.C.2. "Civil Primary Training," Mr. H. G. Travers. 6.30 p.m.

Friday, November 4th.

British Science Guild.—Burton-on-Trent. Alexandra Pedler Lecture, 1932. "Animals as a National Asset and Responsibility," by Professor F. T. G. Hobday, C.M.G.

Chelsea Polytechnic.—Manresa-road, S.W.3. Opening building extension. Presentation of Diplomas and Certificates. 8 p.m.

Chemical Engineering Group.—Royal Technical College, Glasgow. "Ceramic Insulators: Their Manufacture and Testing," Mr. C. S. Garland. 7.30 p.m.

Inst. of British Foundrymen.—Chamber of Commerce, Birmingham. "Properties of Pig Irons," Mr. J. E. Hurst. 7.30 p.m.

Inst. of British Foundrymen.—Technical College, Preston. "Source and Elimination of Blow-holes, Cracks, and Drawn Holes," Mr. C. H. Kain. 7.30 p.m.

Inst. of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W.1. The Thomas Hawksley Lecture. "Atomic Projectiles and their Applications," by Professor Lord Rutherford, F.R.S. 6 p.m.

Inst. of Metals: Sheffield.—In Non-Ferrous Section of Applied Science Dept. of University, Sheffield. "Nickel-silver Alloys for the Electro-plate Trades," Mr. W. R. Barclay. 7.30 p.m.

Inst. of Production Engineers: London Section.—In the Council Room, Society of Motor Manufacturers and Traders, 83, Pall Mall, S.W.1. "Application of Various Steels," by Mr. J. W. Johnson. 7.30 p.m.

Inst. of Sanitary Engineers.—266, Vauxhall Bridge-road, S.W.1. "Guildford Corporation Waterworks Extensions, 1922–31," Mr. P. Griffith. 6 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Informal meeting. 7.30 p.m.

Railway Club.—57, Fetter-lane, Fleet-street, E.C.4. "The Union of Road and Rail," by Mr. Edward Codd. 7.30 p.m.

Saturday, November 5th.

Inst. of British Foundrymen.—Royal Technical College, Glasgow. "Plaster Patterns in General Foundry Practice," Mr. R. Ballantine. 4 p.m.

Inst. of British Foundrymen.—Technical College, Monks-road, Lincoln. "High-strength Light Alloys," Mr. W. C. Devereux. 7 p.m.

Inst. of British Foundrymen.—College of Technology, Manchester. "Contraction, Distortion, and Camber in Grey Iron Castings," Mr. E. Longden. 4 p.m.

Monday, November 7th.

Inst. of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C.2. Discussion, "The Present Depression—Is Electricity the Way Out?" Opener, Mr. F. J. Shipley. 7 p.m.

Soc. of Chemical Industry: London Section.—Burlington House, W.1. "Fermentation of Cellulose," by Mr. H. M. Langwell; "Examination of Asphalt Mixtures for Road Pavements," by Mr. Norman H. Taylor. (This paper will be presented by Professor M. G. Clements.) 8 p.m.

Wolverhampton and District Engineering Soc.—Victoria Hotel, Wolverhampton. "Design and Construction of Ironbridge Power Station," Mr. E. F. Hetherington. 7.30 p.m.

Tuesday, November 8th.

Hull Association of Engineers.—Municipal Technical College, Park-street, Hull. "Heat and Acid-resisting Alloys," by Mr. J. Ferdinand Kayser. 7.15 p.m.

Inst. of Automobile Engineers.—King's Head Hotel, Coventry. "Repairs and the Importance of the Repair Department," Mr. S. H. Troughton. 7.30 p.m.

Inst. of Electrical Engineers: N. Midland.—Hotel Metropole, Leeds. "Metal-clad Switchgear, Automatic Protection, and Remote Control with Particular Reference to Developments during the Last Seven Years," Mr. H. W. Clothier. 7 p.m.

Inst. of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow, C.2. "Ship Furnishing and Decoration: A Plea for Modernity," Mr. W. A. Gibson Martin. 7.30 p.m.

Inst. of Heating and Ventilating Engineers: Assoc. Members and Graduates.—Borough Polytechnic, S.E.1. "Practical Side of Ventilation," Mr. W. H. Rogers. 7 p.m.

Inst. of Heating and Ventilating Engineers: Assoc. Members and Graduates.—Engineers' Club, Manchester. "Steam Boilers," Mr. W. Atkinson. 7 p.m.

Inst. of Marine Engineers.—The Minories, E.C.3. "Production, Handling, and Marketing of Coal for Marine Purposes," Mr. W. J. Drummond. 6 p.m.

Inst. of Production Engineers; Eastern Counties Section.—In the Library, Lecture Hall, Ipswich. "Conflicting Issues in Design and Production," Mr. L. H. Pomeroy. 7.30 p.m.

Inst. of Transport.—Queen's Hotel, Birmingham. "The 'Salter Report' and its Effect on Modern Road Transport," Mr. J. S. Nicholl. 6 p.m.

Staffordshire Iron and Steel Inst.—Girls' High School, Dudley. "High Elastic Limit Mild Steel," Mr. F. G. Martin. 7 p.m.

Wednesday, November 9th.

Inst. of Civil Engineers: Manchester and District.—Visit, British Insulated Cables, Ltd., Prescot. 1 p.m.

Inst. of Engineering Inspection.—In the Lecture Hall of the Royal Society of Arts, John-street, Adelphi, W.C.2. "The Development of Water-tube Boilers," by Mr. C. H. Davy. 5.30 p.m.

Inst. of Production Engineers: Coventry Section.—King's Head Hotel, Coventry. "The Manufacture of Copper Wire," by Mr. G. H. Fox. 7.30 p.m.

Inst. of Production Engineers: Luton, Bedford, and District Section.—Royal Hotel, Luton. "Modern Heat Treatment," by Mr. H. Toplis. 7.30 p.m.

Thursday, November 10th.

Inst. of British Foundrymen.—Charing Cross Hotel, London, W.C.2. "Fuel Oil as Applied to the Ferrous and Non-ferrous Foundry Industries," Mr. T. F. Unwin. 8 p.m.

Inst. of British Foundrymen.—Municipal College, Burnley. "Craftsmen or Specialists?" Mr. J. J. Clark. 7.15 p.m.

Inst. of Locomotive Engineers.—Inst. of Mech. Engineers, Storey's-gate, S.W.1. Informal meeting. 6 p.m.

Inst. of Marine Engineers: Junior Section.—The Minories, E.C.3. "Running and Maintenance of Steam Reciprocating Machinery," Mr. R. Jolly. 7 p.m.

Inst. of Mechanical Engineers: Graduates.—Visit to Ford Motor Company, Dagenham.

Inst. of Metals: London Local.—Royal School of Mines, S. Kensington, S.W.7. "Non-ferrous Metals and Alloys in Railway Engineering," Sir Henry Fowler. 8 p.m.

Inst. of Metals: Swansea.—Y.M.C.A., Swansea. "Some Stainless Alloys," Dr. L. B. Pfeil. 6.15 p.m.

Inst. of Structural Engineers.—Hotel Metropole, Leeds. Discussion, "Reinforced Concrete v. Structural Steel." Openers, Mr. N. B. Liversedge and Mr. A. J. Hodgkinson. 7 p.m.

Manchester Association of Engineers.—Y.M.C.A., Peter-street, Manchester. "The Metallurgical Aspect of Fusion Welding," Dr. J. H. Paterson. 7.30 p.m.

Friday, November 11th.

Inst. of British Foundrymen.—Cleveland Scientific and Technical Institute, Middlesbrough. "Furnace Linings," Mr. J. F. Hyslop. 7.45 p.m.

Inst. of Electrical Engineers: London Students.—Savoy-place, W.C.2. "Some of the Less Well-known Methods of Electric Propulsion," Mr. R. J. Eldred. 6.15 p.m.

Inst. of Mechanical Engineers.—Storey's-gate, S.W.1. Informal meeting. 7 p.m.

Inst. of Metals: Sheffield.—In Non-ferrous Section of Applied Science Dept. of University, Sheffield. "Practical Digest on Cluster Mills, Four-high Mills, &c., and Trend of Rolling Mill Design," Mr. E. Williams. 7.30 p.m.

Inst. of Transport.—Station Hotel, Newcastle-upon-Tyne. "An Englishman's Impression of the Italian State Railways," Mr. R. C. V. Ash. 7.30 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Annual General Meeting. 7.30 p.m.

Manchester Association of Engineers.—Engineers' Club, Albert-square, Manchester. "The Relation of the Offices to the Shops," by Mr. F. C. Lawrence. 7.15 p.m.

North-East Coast Inst. of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "Fires at Sea," by Mr. E. Leslie Champness. 6 p.m.

Saturday, November 12th.

Inst. of British Foundrymen.—Technical College, Bradford. Discussion, "Iron Castings *versus* Fabricated Parts," Messrs. A. W. Walker and E. B. Shore. 6.30 p.m.

Inst. of British Foundrymen.—Merchant Venturers' Technical College, Bristol. "Some Methods of Production in a Modern Malleable Ironfoundry," Mr. H. J. Beck. 6.30 p.m.

Inst. of British Foundrymen.—Girls' Welfare Hall, Falkirk Iron Co., Falkirk. "Heat-resisting Cast Iron," Mr. J. W. Donaldson. 6 p.m.

Inst. of Electrical Engineers: London Students.—Visit, Home Office Industrial Museum, Horseferry-road, S.W.1. 3 p.m.

Faraday House Dinner.—The annual dinner of the Faraday House Old Students' Association was held at the Savoy Hotel on Friday evening, October 21st. Nearly 300 members and guests attended, under the chairmanship of Major C. E. Prince, O.B.E., M.I.E.E. Colonel K. Edgcumbe, Past President of the Institution of Electrical Engineers, proposed the toast of "Faraday House and its Old Students," and Dr. Russell, the Principal, responded. He mentioned the good work done by old students during the past year and gave a list of honours and appointments obtained. These included the presidentship of three engineering societies. Mr. C. C. Paterson proposed the toast of "The Guests" and Sir Hugo Hirst and Sir Philip Dawson responded. "The Chairman" was proposed by Mr. S. B. Haslam. Amongst others present were the Earl of Rothes, Sir J. E. Petavel, Colonel Sir Henry Lyons, Sir Philip Nash, Sir Robert Robertson, Dr. S. L. Pearce, Messrs. T. P. Wilmshurst, W. W. Lackie, W. B. Woodhouse, Captain Donaldson, Colonel Morcom, Messrs. Roger T. Smith, and Vincent de Ferranti.